Supplemental Remedial Investigation & Feasibility Study

Volume 1: RI Report

Whatcom Waterway Site
Bellingham, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134-1162

RETEC Project Number: PORTB-18876-240

Prepared for:

The Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98225

Public Review Draft

October 10, 2006

Supplemental Remedial Investigation & Feasibility Study

Volume 1: RI Report

Whatcom Waterway Site
Bellingham, Washington

Prepared by:

The RETEC Group, Inc.
1011 SW Klickitat Way, Suite 207
Seattle, Washington 98134-1162

RETEC Project Number: PORTB-18876-240

Prepared for:

The Port of Bellingham
1801 Roeder Avenue
Bellingham, Washington 98225

Prepared by:

Jamie C. Stevens for:

Anne Fitzpatrick, Environmental Scientist

Jamie C. Stevens

Jamie Stevens, Environmental Engineer

Reviewed by:

Mark Larsen , Senior Project Manager

October 10, 2006

Table of Contents

Table of Contents

List of Tables

List of Figures

List of Appendices

Abbreviations and Acronyms

AET	apparent effects threshold
ASB	aerated stabilization basin
BEP	bis-2-ethylhexylphthalate
BSL	bioaccumulation screening level
BT	bioaccumulation trigger
CAP	Cleanup Action Plan
Corps	Army Corps of Engineers
cm	centimeter
cm/yr	centimeters per year
Cs-137	cesium
CSL	cleanup screening level
CSM	site conceptual model
CSO	combined sewer overflow
CST	column settling tests
DNR	Department of Natural Resources
dpm/g	disintegrations per minute per year
DRET	dredge elutriate test
Ecology	Department of Ecology
ECRT	electro-chemical reductive technology
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRMS	flood insurance rate maps
g/cm^2 yr	grams per square centimeter per year
g/cm^3	grams per cubic meter
GP	Georgia Pacific
HPAH	high polycyclic aromatic hydrocarbon
IRIS	Integrated Risk Information System
km^2	square kilometers
LAET	lowest apparent effects threshold
LPAH	low polycyclic aromatic hydrocarbon
m/sec	meters per second
M^3	cubic meters
MCUL	minimum cleanup level
MET	modified elutriate test
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MLLW	mean lower low water
MTCA	Model Toxics Control Act
ng/Kg	nanograms per kilogram
NMFS	National Marine Fisheries Service
NOAA	National Oceanic & Atmospheric Administration
NPDES	non-point discharge
^oC	degrees Celsius

Abbreviations and Acronyms

OMMP	Operations, Maintenance, and Monitoring Plan
PAH	polyaromatic hydrocarbons
Pb-210	lead
PCLT	pancake column leach test
Pilot	Bellingham Bay Demonstration Pilot
PMA	Port Management Agreement
ppt	parts per thousand
PRDE	pre-remedial design evaluation
PSDDA	Puget Sound dredge disposal analysis
RfD	reference dose
RI/FS	Remedial Action/Feasibility Study
RTDF	Remediation Technologies Development Forum
SAP	sampling and analysis plan
SEPA	State Environment Policy Act
SMP	Shoreline Master Program
SMS	sediment management standards
SPM	settled particulate matter
SQS	sediment quality standard
TCDD	tetrachlorodibezodioxin
TCLP	toxicity characteristics leaching procedure
TEC	toxicity equivalent concentration
TOC	total organic carbon
TSS	total suspended solids
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
WASP	Water Quality Analysis Simulation Program
WW	Whatcom Waterway
WWTP	wastewater treatment plant
μg/L	micrograms per liter

1 Introduction

This document is Volume 1 of the Draft Supplemental Remedial Investigation and Feasibility Study (RI/FS) for the Whatcom Waterway Site in Bellingham. Together with the companion Draft Supplemental Environmental Impact Statement (EIS), the RI/FS document describes the results of environmental investigations of the Whatcom Waterway Site, describes and evaluates a range of potential remedial alternatives, and identifies a preferred remedial alternative.

This document (Volume 1) contains the Remedial Investigation component of the RI/FS, which describes the nature and extent of contamination and the environmental setting at the site. The Feasibility Study (Volume 2) contains the evaluation of cleanup technologies and alternatives that can be used to conduct cleanup of the site. Volume 2 also identifies a preferred remedial alternative that best meets regulatory requirements. This document was prepared consistent with the requirements of the Model Toxics Control Act (MTCA) regulations and the Sediment Management Standards (SMS).

After considering public comment, the RI/FS will be finalized and the Washington Department of Ecology (Ecology) will preliminarily select a cleanup alternative for the site that will be articulated for public review in a draft Cleanup Action Plan (CAP). Following public review of the CAP, the cleanup will move forward into design, permitting, construction, and long-term monitoring.

1.1 Site Description and Background

The Whatcom Waterway Site is located within Bellingham Bay. The locations and characteristics of the site are shown in Figure 2-1. The site includes lands that have been impacted by contaminants historically released from industrial waterfront activities, including mercury discharges from the former Georgia Pacific (GP) Chlor-Alkali Plant. The Chlor-Alkali Plant was constructed by GP in 1965 to produce chlorine and sodium hydroxide for use in bleaching and pulping wood fiber. The Chlor-Alkali Plant discharged mercury-containing wastewater into the Whatcom Waterway during the late 1960s and 1970s. Initial environmental investigations of the site identified mercury in sediment at concentrations that exceed applicable standards, as well other contaminants from industrial releases.

The main state law that governs the cleanup of contaminated sites is the MTCA. When contaminated sediments are involved, the cleanup levels and other procedures are also regulated by the SMS. MTCA regulations specify criteria for the evaluation and conduct of a cleanup action. SMS regulations dictate the standards for cleanup. Under both laws, a cleanup must protect human health and the environment, meet environmental standards in other laws that apply, and provide for monitoring to confirm compliance with site cleanup levels.

The key MTCA decision-making document for site cleanup actions is the RI/FS. In the RI/FS, different potential alternatives for conducting a site cleanup action are defined. The alternatives are then evaluated against MTCA remedy selection criteria, and one or more preferred alternatives are selected. After reviewing the RI/FS study, and after consideration of public comment, Ecology then selects a cleanup method and documents that selection in a document known as the CAP. Following public review of the CAP, the cleanup will move forward into design, permitting, construction and long-term monitoring.

The RI/FS process for the Whatcom Waterway Site was initiated under Ecology oversight in 1996 consistent with Agreed Order DE 95TC-N399. The RI/FS study process initially included detailed sampling and analysis in 1996 and 1998. These sampling events formed the basis for development of an RI/FS report in 2000.

In parallel with the RI/FS activities, the Bellingham Bay Comprehensive Strategy EIS was prepared. The EIS was both a project-specific EIS, evaluating a range of cleanup alternatives for the Whatcom Waterway Site, and a programmatic EIS, evaluating the Bellingham Bay Comprehensive Strategy. The Comprehensive Strategy was developed by an interagency consortium known as the Bellingham Bay Demonstration Pilot (Pilot). The Pilot brought together a partnership of agencies, tribes, local government, and businesses known collectively as the Pilot Work Group, to develop a cooperative approach to expedite source control, sediment cleanup and associated habitat restoration in Bellingham Bay. As part of the approach, the Pilot Work Group developed a Comprehensive Strategy that considered contaminated sediments, sources of pollution, habitat restoration, and in-water and shoreline land use from a Bay-wide perspective. The strategy integrated this information to identify priority issues requiring action in the near-term and to provide long-term guidance to decision-makers. The Comprehensive Strategy was finalized as a Final Environmental Impact Statement in October 2000 prepared under the State Environmental Policy Act (SEPA). It was a companion document to the 2000 RI/FS for the Whatcom Waterway Site.

Since 2000, the Bellingham Waterfront has undergone a series of dramatic land use changes, including the closure of the Georgia Pacific pulp mill and chemical plant, the sale of 137 acres of GP-owned waterfront property to the Port of Bellingham (Port), additional property ownership changes in the Central Waterfront Area, and City of Bellingham/Port land use planning initiatives that shift waterfront uses from industrial to mixed-use development and zoning.

This RI/FS incorporates the results of environmental investigations conducted since completion of the original RI/FS in 2000, updates previously evaluated cleanup alternatives, and describes and evaluates new cleanup alternatives that reflect changes in land use. The EIS companion document to this RI/FS is also currently available for public review. This RI/FS, the companion EIS and public comment on both documents will inform Ecology's preliminary selection of a cleanup alternative for the Whatcom Waterway Site. The preliminary selected alternative will be articulated for public review in a draft CAP. Following public review of the CAP, the cleanup will move forward into design, permitting, construction, and long-term monitoring.

1.2 Document Organization

This document is intended to be read in conjunction with the Feasibility Study report (Volume 2 of the RI/FS) and in conjunction with the companion EIS document (bound separately). This document contains periodic references to those other two documents.

This Remedial Investigation was prepared consistent with the process defined under MTCA and SMS. The RI document is organized as follows:

- Section 2 of this report provides a history of the site, an overview of previous environmental studies, and cleanup actions conducted to date.

- Section 3 of the document then summarizes the environmental site setting, including the physical site features, natural resources, and area land use and navigational uses.

- Site screening levels developed as part of the RI/FS are summarized in Section 4. This section summarizes the principal environmental receptors and exposure pathways for which the screening levels are protective.

- The nature and extent of site contamination problems are defined in Section 5. This section summarizes environmental data collected during the previous RI/FS activities (1996-2000) and during supplemental studies between 2002 and 2004. Information discussed in this section includes contaminant distribution in surface and subsurface sediments.

- Section 6 summarizes processes that affect the fate and transport of site contaminants. This section includes an assessment of sediment source control and natural recovery processes, and the other factors that may impact sediment stability.

- Section 7 contains the results of pre-design engineering evaluations performed in support of the Feasibility Study.

- Section 8 provides an overall summary of the RI, including the presentation of an overall Conceptual Site Model. The Conceptual Site Model incorporates the key findings of the RI study including contaminants and sources, the nature and extent of contamination, contaminant fate and transport processes, and the principal human health and ecological receptors.

- Section 9 lists references cited in the RI document. Backup data and relevant supporting information are attached as appendices to this report.

2 Project Background

This section provides an overview of the history of the Whatcom Waterway Site, including the results of previous investigation and cleanup actions. The purpose of this Supplemental RI/FS is discussed, along with the relationship between the RI/FS and the companion EIS. This information is provided as background and context to assist the reader in understanding the significance of the RI findings that are presented in the subsequent sections of this report.

2.1 Whatcom Waterway Site History

The Whatcom Waterway Site ("Site") consists of lands located within and adjacent to the Whatcom Waterway in Bellingham, Washington (Figure 2-1). Current land ownership patterns are summarized in Figure 2-2. Mercury and other contaminants have been detected within the site at concentrations that exceed cleanup standards defined under MTCA and SMS regulations.

2.1.1 Site-Area Historic Uses

The vicinity of the Whatcom Waterway Site area has been used for industrial activities by multiple parties since the late 1800s. Industrial operations conducted within the area include, but are not limited to, the following:

- Coal shipping
- Log rafting
- Pulp and paper mill operation
- Chemical manufacturing
- Cargo terminal operations
- Grain shipment
- Fish processing and cannery operations
- Bulk petroleum terminal operations (two facilities)
- Boatyard operation
- Handling of sand, gravel, and other mineral ores
- Municipal landfill operations
- Multiple lumber mills and a wood products manufacturing operations
- Operation of a co-generation power plant.

Pulp and paper mills have been operated on the Pulp and Tissue Mill Site (Figure 2-1). In the early 1900s the mills were operated by Puget Sound Pulp and Timber. The mills were later sold to GP in the 1960s.

In 1965 GP constructed a Chlor-Alkali Plant adjacent to the Log Pond. The plant operated between 1965 and 1999 using a mercury cell process to produce chlorine, sodium hydroxide, and hydrogen. Between 1965 and 1971, mercury-containing wastewaters from the Chlor-Alkali Plant were discharged directly into the Log Pond. Between 1971 and 1979 pretreatment measures were installed to reduce mercury discharges. Chlor-alkali plant wastewater discharges to the Log Pond area were discontinued in 1979, following construction of the Aerated Stabilization Basin (ASB).

The ASB facility was constructed by GP during 1978 and 1979 for management of wastewaters in compliance with the Clean Water Act. The outfall from the ASB continues to be owned by GP and wastewater and sediment quality in that area are monitored under the National Pollutant Discharge Elimination System (NPDES) permit program (Permit No. WA-000109-1).

The Whatcom Waterway was listed by Ecology as a contaminated site in the early 1990s. The site RI/FS process was initiated after completion of a site hazard assessment by Ecology, and after development of an Agreed Order between Ecology and GP.

2.1.2 Previous RI/FS and EIS Studies

In 1996, the RI/FS process for the Whatcom Waterway Site was initiated under a MTCA Agreed Order (DE 95TC-N399) between GP and Ecology. Detailed sampling and analysis was performed in 1996 and 1998, and an RI/FS report was completed in July 2000 following public notice and opportunity to comment. Sediment data summaries from the 2000 RI/FS are attached as Appendix B.

In parallel with the RI/FS activities, the Bellingham Bay Comprehensive Strategy EIS was prepared. The EIS was both a project-specific EIS, evaluating a range of cleanup alternatives for the Whatcom Waterway Site, and a programmatic EIS, evaluating the Bellingham Bay Comprehensive Strategy. The Comprehensive Strategy was developed by an interagency consortium known as the Pilot. The Pilot brought together a cooperative partnership of agencies, tribes, local government, and businesses known collectively as the Pilot Work Group, to develop a cooperative approach to expedite source control, sediment cleanup and associated habitat restoration in Bellingham Bay. As part of the approach, the Pilot Work Group developed a Comprehensive Strategy that considered contaminated sediments, sources of pollution, habitat restoration and in-water and shoreline land use from a Bay-wide perspective. The strategy integrated this information to identify priority issues requiring action in the near-term and to provide long-term guidance to decision-makers.

The Comprehensive Strategy was finalized as a Final Environmental Impact Statement (FEIS) in October 2000 prepared under SEPA. While it was published as a companion document to the 2000 RI/FS for the Whatcom Waterway site, and while it addressed project impacts associated with the MTCA cleanup of the Whatcom Waterway site, the 2000 EIS contained other contemplated actions above-and-beyond the regulatory requirements of the MTCA site cleanup process.

Consistency with the Pilot Comprehensive Strategy and the Pilot Goals is voluntary. However, the use of the Pilot goals provides an additional basis by which the qualitative benefits or short-comings of a remedial alternative can be measured. The Comprehensive Strategy included a number of Baywide recommendations for achieving the seven goals of the Pilot. These Baywide general recommendations were programmatic in nature and were not tied to specific project alternatives or actions. The Comprehensive Strategy also includes specific strategy recommendations for each of nine geographic subareas within Bellingham Bay. These Subarea Strategies provided greater detail on priorities and recommended actions for land use, habitat, sediment cleanup and source control within each geographic subarea (Appendix A of the 2006 Supplemental EIS for the Whatcom Waterway Site). The SEPA evaluation included in the 2000 FEIS have been updated in the EIS to include the updated site data, area land use changes, and actions taken at other cleanup sites. These changes do not affect the programmatic elements of the Pilot which are addressed by the 2000 FEIS.

Absent significant changes or new information, the 2000 RI/FS and EIS documents would have formed the basis for Ecology's selection of a cleanup approach for the Whatcom Waterway Site. That selection would have been formalized in a CAP. However, subsequent events and new information have made it necessary to complete this supplemental RI/FS and the companion Supplemental EIS, as described in Section 2.2 below.

In 2001 GP closed its pulp mill which dramatically reduced the wastewater treatment needs associated with process operations. The ASB was constructed in 1978 within the Whatcom Waterway Site area, on lands impacted by mercury discharges from the Chlor-Alkali Plant. In addition, the ASB facility has received effluent from the Chlor-Alkali Plant and the pulp and tissue mills. The ASB contamination from these sources was not addressed in the 2000 Whatcom Waterway RI/FS investigations of remedial alternatives, because at that time it was an operational wastewater treatment facility. However, with the reduced treatment needs resulting from the 2001 closure of the GP pulp mill, the contamination issues could be addressed as part of the cleanup of the Whatcom Waterway Site.

To address this new portion of the Whatcom Waterway Site, a new remedial alternative was evaluated in 2002 through a Supplemental FS (Anchor, 2002a) and companion Supplemental EIS (Anchor, 2002b). The new remedial alternative proposed using a portion of the ASB as a near shore fill disposal facility for disposal of contaminated materials removed from areas of the Whatcom Waterway Site outside the ASB and from other contaminated sediment sites in Bellingham Bay. The proposal included maintenance of a down-sized wastewater treatment facility constructed within the footprint of the existing ASB.

2.1.3 Log Pond Interim Remedial Action

In late 2000 and early 2001, Georgia Pacific implemented a combined sediment cleanup and habitat restoration action at the Log Pond, part of the Whatcom Waterway Site. The work was performed under the terms of a MTCA Interim Action Agreed Order with Ecology and as authorized under Clean Water Act Permit No. 2000-2-00424 administered by the U.S. Army Corps of Engineers (Corps). The Log Pond project beneficially reused 43,000 cubic yards of clean dredging materials from the Swinomish navigation channel and from the Squalicum Waterway. The materials were used to cap contaminated sediments in the Log Pond, and to improve habitat substrate and elevations for use by aquatic organisms. The habitat restoration component of the project was voluntarily implemented by GP in accordance with the Bellingham Bay Comprehensive Strategy.

Monitoring of the Log Pond Interim Action has been performed in Year 1, Year 2 and Year 5. The results of the Year 5 monitoring event are attached as Appendix I to this RI. Results of monitoring have confirmed that the cap is successfully meeting most performance objectives, with the exception of some erosion at the shoreline edges of the cap. Enhancements to the shoreline edges of the Log Pond cap to correct these erosional areas cap have been incorporated into the Feasibility Study. Monitoring results have documented the development of habitat functions within the Log Pond (Anchor, 2001b and 2002c). The Year 5 Monitoring Report is attached as Appendix I.

2.1.4 New Site Data

In spring and summer of 2002, following completion of the 2002 Supplemental FS and EIS, additional site data were collected to inform future remedial design activities. The results of these investigations were summarized in a Pre-Remedial Design Evaluation (PRDE) report (attached as Appendix A). The PRDE data collection included the following major work elements:

- Surface sediment sampling to document natural recovery rates and refine the boundaries of the area of sediment exceeding site cleanup levels
- Subsurface testing of samples located in the Outer Waterway area
- Contaminant mobility testing for use in evaluation and design of confined disposal alternatives

- Geotechnical testing, column settling tests and consolidation tests of site sediments for use in dredging, capping and confined disposal alternatives evaluations

In 2003 Ecology requested additional data collection to better characterize contamination within the ASB. This work was conducted under Addendum 4 of the RI/FS Work Plan and included testing of chemical and physical properties of the ASB sludges and underlying native sands. This sampling was performed in the summer of 2003. Data collected during that investigation are attached as Appendix C.

During 2004 additional site characterization data were collected at the ASB facility. This work was conducted under Addendum No. 5 of the RI/FS Work Plan. The investigation included testing of the chemical and physical properties of the ASB berm sands, bathymetric surveys of the ASB, and dewatering tests of the ASB sludges. Sampling was performed between July and September of 2004. Data collected during the 2004 investigations are attached as Appendix D.

2.1.5 Recent Land Use Changes

Extensive changes have occurred between completion of the 2000 RI/FS and EIS and the present, including the following:

- 1999 closure of the GP Chlor-Alkali Plant.

- 2001 closure of the GP pulp mill and chemical plant.

- 2004 development of the Waterfront Vision and Framework Plan by the Waterfront Futures Group, a community land use visioning effort initiated by the City and the Port and involving Bellingham citizens. The group developed a suite of Guiding Principles and Recommendations that addressed land use priorities for six areas of Bellingham Bay.

- Completion of marina demand studies and marina alternatives sitting analyses by the Port, including identification of the ASB as a preferred location for development of a future small boat marina.

- January 2005 Port acquisition of 137 acres of GP waterfront property, including portions of the Whatcom Waterway Site, in accordance with the Waterfront Vision and Framework Plan.

- Additional evaluations of navigation and waterfront infrastructure needs by the Port, DNR and the Army Corps of Engineers relating to the Whatcom Waterway. These evaluations included development of a November 2005 Port-DNR Memorandum of

Understanding relating to changing waterfront land use needs, development of a May 2006 Port Resolution #1230 and corresponding federal legislation to make adjustments to the dimensions of the federal channel within the Whatcom Waterway. These changes are intended to support the development of waterfront land use, public access, navigation, and habitat restoration improvements consistent with the Waterfront Vision and Framework Plan, while maintaining the viability of the Bellingham Shipping Terminal.

- Initiation of a joint Port-City Master Planning process for the waterfront area in the vicinity of the Whatcom Waterway site. This process is being implemented consistent with Port-City interlocal agreements dated January 2005 and July 2006. The interlocal agreements and the planning actions implemented by those agreements propose to redevelop the area to support mixed residential, commercial, light industrial, institutional and recreational uses and to support the development of transportation, utilities, public access, parks and open space and marine infrastructure including a marina, boat launch, transient moorage and associated parking. Consistent with the interlocal agreements, the properties within the New Whatcom planning area have been rezoned to mixed-use zoning, contingent on finalization of an approved Master Plan.

- Pending update to the City Shoreline Master Program (SMP). The SMP is a state-mandated shoreline land use planning effort. The SMP update is expected to embrace and elaborate on the work of the Waterfront Futures Group.

2.2 Objective of this Supplemental RI/FS

This Supplemental RI/FS integrates new site data with the project historical data, providing a comprehensive summary of site information. The RI/FS also presents and evaluates a modified range of cleanup alternatives for the site. Lastly, since 2000 a number of other changes have occurred that require updating through this Supplemental RI/FS;

- **Changes to Cleanup Costs:** Updated unit cost information is available from multiple sediment cleanup projects that have been completed since 2000. The RI/FS incorporates this updated cost information.

- **Endangered Species Listings:** The RI discussion of natural resources has been updated to reflect current information, including the recent listing of Puget Sound Orcas as endangered under the Endangered Species Act.

- **Multi-User Disposal Site Status:** The initial concept presented in the 2000 RI/FS and the companion EIS proposed the development of a multi-user disposal facility in Bellingham Bay for management of locally-generated contaminated sediments. However, the multi-user disposal facility has proven to be infeasible. The RI/FS and EIS require updating to reflect current project alternatives independent of the multi-user disposal facility concept.

2.3 Relationship between the RI/FS and the EIS

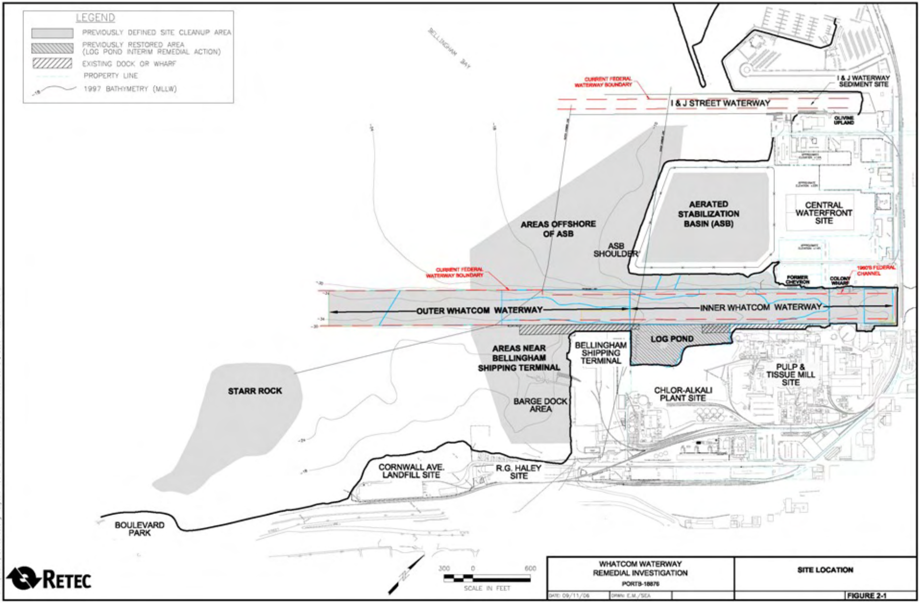
The RI/FS and the EIS documents are both used by Ecology, in conjunction with public and stakeholder comments, to inform its decision regarding the cleanup of impacted sites. However, the RI/FS and EIS documents each address different regulatory and policy requirements, and inform different aspects of the cleanup decision as summarized in Table 2-1.

Table 2-1 Relationship between the RI/FS and the EIS

	RI/FS	EIS
Regulatory Basis	Model Toxics Control Act (WAC 173-340) Sediment Management Standards (WAC 173-204)	State Environmental Policy Act (WAC 197-11)
Information Analysis Roles	Assess the Site Environmental Setting (RI) Document the Nature & Extent of Contamination (RI) Define Applicable Cleanup Requirements (FS) Screen cleanup technologies for potential application (FS)	Document the Characteristics of the Affected Environment within which the cleanup project is to be performed Determine how the environment may be affected by the project.
Alternatives Analysis Functions	Detailed analysis of multiple cleanup alternatives (FS): • Development of engineering design concepts Schedule projections • Cost estimates	Assessment of measures that may be used to mitigate environmental impacts of the project alternatives as required by SEPA regulations. Determine differences in environmental impacts and mitigation needs between the different project alternatives.
Selection of Preferred Alternative(s)	Ranking of cleanup alternatives using MTCA and SMS regulatory criteria.	Provides the environmental impact analysis component of the SMS regulatory criteria.[1]

Note:

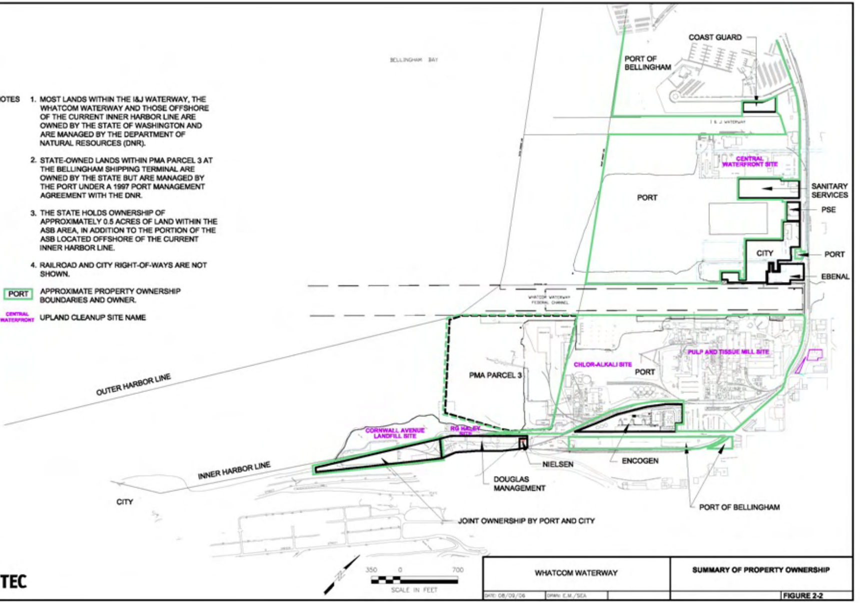
[1] The EIS also evaluates alternatives against the seven goals developed by the Pilot Work Group. Consistency of a project with these goals is not required by MTCA or other applicable regulations. Rather the Pilot goals are voluntary, reflecting the collective interests of the Work Group and the desired outcome of the Pilot. They provide additional benchmarks against which the appropriateness of project alternatives can be measured.


LEGEND
PREVIOUSLY DEFINED SITE CLEANUP AREA
PREVIOUSLY RESTORED AREA (LOG POND INTERIM REMEDIAL ACTION)
EXISTING DOCK OR WHARF
PROPERTY LINE
1997 BATHYMETRY (MLLW)
BELLINGHAM BAY
CURRENT FEDERAL WATERWAY BOUNDARY
I & J STREET WATERWAY
I & J WATERWAY SEDIMENT SITE
OLIVINE UPLAND
AERATED STABILIZATION BASIN (ASB)
CENTRAL WATERFRONT SITE
AREAS OFFSHORE OF ASB
ASB SHOULDER
CURRENT FEDERAL WATERWAY BOUNDARY
1960'S FEDERAL CHANNEL
FORMER CHEVRON
COLONY WHARF
OUTER WHATCOM WATERWAY
INNER WHATCOM WATERWAY
LOG POND
BELLINGHAM SHIPPING TERMINAL
AREAS NEAR BELLINGHAM SHIPPING TERMINAL
PULP & TISSUE MILL SITE
CHLOR-ALKALI PLANT SITE
STARR ROCK
BARGE DOCK AREA
CORNWALL AVE. LANDFILL SITE
R.G. HALEY SITE
BOULEVARD PARK
RETEC
300 0 600
SCALE IN FEET
WHATCOM WATERWAY REMEDIAL INVESTIGATION
PORTB-18876
DATE: 09/11/06
DRWN: E.M./SEA
SITE LOCATION
FIGURE 2-1

NOTES
1. MOST LANDS WITHIN THE I&J WATERWAY, THE WHATCOM WATERWAY AND THOSE OFFSHORE OF THE CURRENT INNER HARBOR LINE ARE OWNED BY THE STATE OF WASHINGTON AND ARE MANAGED BY THE DEPARTMENT OF NATURAL RESOURCES (DNR).
2. STATE-OWNED LANDS WITHIN PMA PARCEL 3 AT THE BELLINGHAM SHIPPING TERMINAL ARE OWNED BY THE STATE BUT ARE MANAGED BY THE PORT UNDER A 1997 PORT MANAGEMENT AGREEMENT WITH THE DNR.
3. THE STATE HOLDS OWNERSHIP OF APPROXIMATELY 0.5 ACRES OF LAND WITHIN THE ASB AREA, IN ADDITION TO THE PORTION OF THE ASB LOCATED OFFSHORE OF THE CURRENT INNER HARBOR LINE.
4. RAILROAD AND CITY RIGHT-OF-WAYS ARE NOT SHOWN.

PORT — APPROXIMATE PROPERTY OWNERSHIP BOUNDARIES AND OWNER.

CENTRAL WATERFRONT — UPLAND CLEANUP SITE NAME



RETEC

WHATCOM WATERWAY

SUMMARY OF PROPERTY OWNERSHIP

DATE: 08/09/06 DRWN: E.M./SEA

FIGURE 2-2

File: H:\18876\18876S11.dwg Layout: FIGURE 1 User: emarshall Plotted: Aug 10, 2006 - 11:13am Xref's:

3 Environmental Setting

This section describes the environmental setting of the Whatcom Waterway Site. Information discussed in this section includes the physical site features, area natural resources, and land use and navigation patterns.

3.1 Physical Conditions

Physical conditions are relevant at contaminated sites because they affect the fate of impacted sediments and because they are relevant to the discussion of natural resources, land use and navigation patterns. Physical conditions discussed below include the following:

- Site bathymetry and shoreline characteristics (Section 3.1.1)
- Surface water circulation patterns (Section 3.1.2)
- Area groundwater studies (Section 3.1.3)
- Sediment physical properties (Section 3.1.4)
- Sediment lithology (Section 3.1.5).

3.1.1 Bathymetry and Shorelines

Figure 3-1 presents existing bathymetric conditions within the site area. This map incorporates 1996 bathymetric soundings collected as part of the RI/FS, a 2004 survey of the ASB, and a 2005 survey of the Log Pond. The following general elevation trends were observed within the different areas of the site:

- **Outer Whatcom Waterway.** The water depths within the Outer Whatcom Waterway are the result of historic navigation dredging activities. As described in Section 3.3.2, dredging activities have been performed within the federal navigation channel and in associated berth areas. Current water depths average between 28 and 38 feet below Mean Lower Low Water (MLLW) within the federal channel. Depths outside the federal channel vary.

- **Inner Whatcom Waterway.** Water depths within the Inner Whatcom Waterway have also been affected by historic navigation dredging activities. As described in Section 3.3.2, the project depths for the federal navigation channel have varied over time, as has the water depth in berth areas. Current water depths in the Inner Waterway generally decrease toward the head of the waterway, with maximum depths greater than 26 feet below MLLW in offshore areas. Extensive shoaled areas exist at the head of the channel and along its sides with some areas of sediments that are exposed at low tides.

- **Log Pond.** Water depths in the Log Pond are relatively shallow, ranging from approximately 10 feet below MLLW to intertidal areas exposed at low tide. The existing Log Pond bathymetry is the result of an interim cleanup action performed in 2000/2001 which isolated contaminated sediment and enhanced habitat quality for juvenile salmonids and invertebrates.

- **Areas Offshore of ASB.** The areas offshore of the ASB have not been subject to significant dredging or fill activity. The mudline elevations in the area immediately offshore of the ASB are relatively shallow, ranging from 6 feet to 8 feet below MLLW. The bottom elevations increase gradually in offshore areas, consistent with the natural bathymetric contours of Bellingham Bay.

- **Areas Near Bellingham Shipping Terminal.** Water depths in the barge dock area near the Bellingham Shipping Terminal have been affected by historical dredging events near the Port docks, and fill activities along the Shipping Terminal shoreline. Water depths range in elevation from 0 to over 28 feet below MLLW.

- **Starr Rock.** The water depths in the Starr Rock area are generally between 30 and 40 feet below MLLW and are consistent with the natural contours of Bellingham Bay. The area includes a natural navigation obstruction (Starr Rock) which protrudes upward over 20 feet above the surrounding bay floor. Water depths in the eastern portion of the Starr Rock areas have also been affected by its use as an authorized sediment disposal site for navigation dredging during the 1960s.

- **ASB.** The GP ASB was initially constructed with a berm enclosing a dredged basin. Water depths in the basin area were initially dredged to elevations at least 12 feet below MLLW. Recent bathymetry indicates that wastewater treatment sludges have accumulated in the ASB. The mudline elevations are irregular, ranging from 4 to 14 feet below MLLW.

- **I&J Waterway.** Like the Whatcom Waterway, the depths in the I&J Waterway have been influenced by navigation dredging in the federal channel and berth areas. The current project depth for the federal channel is 18 feet below MLLW. Water depths within the channel are generally within approximately 2 feet of the project depth. Areas of shoaling area present at the head of the waterway and along the sides of the channel in berth areas.

Shoreline features within the Whatcom Waterway Site area are summarized in Figure 3-2. A brief summary of key shoreline characteristics is provided below.

- **Outer Whatcom Waterway.** The Outer Waterway consists primarily of deep-water areas. At the Bellingham Shipping Terminal, the shoreline has been engineered to support deepwater navigation. The shoreline conditions include an armored slope and bulkhead, topped by an over-water industrial wharf structure. These features are required to provide maintenance of an effective water depth at the pierhead line consistent with the federal navigation channel, and to provide for loading/offloading of vessels at the wharf. The pierhead line is a construction limit line established as part of the federal navigation channel land use restrictions.

- **Inner Whatcom Waterway.** The shorelines of the Inner Whatcom Waterway are varied. Along the southeastern side of the channel at the former GP mill site, the shoreline has historically been engineered with armored slopes, bulkheads and over-water wharf structures. Along the northwestern shoreline, adjacent to the Central Waterfront area, the shoreline was constructed with a mixture of wooden and concrete bulkheads, and steep armored slopes. Over-water wharves are located at the former Chevron property and near the head of the waterway. However, shoaling has occurred along much of the Central Waterfront shoreline area, and many of the bulkheads and wharf structures are in poor condition. At the head of the waterway near Roeder Avenue, an emergent tideflat has developed.

- **Log Pond.** The shoreline conditions in the Log Pond have been modified by the Log Pond interim remedial action completed in 2000 and 2001. A wooden bulkhead remains along the western side, adjacent to the Port terminal. Water depths along this bulkhead are shallow, including a mix of intertidal and subtidal areas. The southwestern and eastern shorelines of the Log Pond include beach areas that were established as part of the cleanup/restoration action. The central shoreline of the Log Pond is more exposed to western wave action and consists of an armored slope. The southwestern, central, and eastern areas transition to a shallow-water tideflat surface created as part of the Log Pond project.

- **Areas Offshore of ASB.** The area immediately north of the ASB includes a shallow tideflat area that has been colonized by eel grass. The eel grass flat transitions to a gravel beach at the foot of Hilton Avenue. Armoring is located in the high intertidal area. The area offshore of the ASB consists of sandy sediments that slope offshore toward deep water, transitioning to fine silt sediments in deeper water. The south side of the ASB, along the Whatcom Waterway, slopes from the base of the ASB berm toward the Whatcom Waterway channel. Sediments in this area consist of a mix of sand and silt sediments. The armor stone of the ASB berm transitions to the Bay sediments at depths of between -2 and -5 feet along this shoreline.

- **Areas Near Bellingham Shipping Terminal.** The shoreline of the barge dock area has been engineered with a steep armored slope to resist wave action. Over-water wharves associated with the Bellingham Shipping Terminal include the main Port wharf, a barge loading terminal and bulkhead constructed in the 1970s, and the barge and chemical loading dock structure. A small natural beach exists in the elbow between the Barge Dock Area and the RG Haley site.

- **Starr Rock.** The Starr Rock area is located in deep-water offshore areas, and is not contiguous with area shorelines. There are no structures in this area other than a navigation float at the Starr Rock navigation obstruction.

- **ASB.** The berm of the GP ASB consists of a composite structure including armor stone, a thick internal sand bedding layer and an internal lining system including asphalt (upper portion), and bentonite clay (lower portion). The characteristics of the berm are described in the cross section in Figure 3-6. The interior of the ASB has been disconnected from Bellingham Bay since 1978 when the berm was completed. Water elevations in the ASB are maintained between 19 and 20 feet above sea level as part of ASB operations. The shoreline surface at that elevation consists of an asphalt erosion control surface. The exterior of the ASB consists of armor stone. The armor stone continues to elevations of between -2 and 8 feet below MLLW where the stone transitions to sandy intertidal and subtidal sediments of Bellingham Bay.

- **I&J Waterway.** The northern shoreline of the I&J Waterway, located along the Bellweather Peninsula, consists of an armored slope. Dock structures have been constructed as part of the Coast Guard facility located near the head of the waterway. An emergent beach and intertidal area has accumulated at the head of the waterway. The southern shoreline of the I&J Waterway, located along the Central Waterfront shoreline, has been engineered for industrial navigation uses using wooden and metal bulkheads and armored slopes. Over-water dock structures are located at the Borstein Seafoods facility and at the Hilton Harbor location.

- **Cornwall and RG Haley Areas.** The Cornwall Avenue Landfill and the RG Haley sites are located south of the Barge Dock areas. Shorelines in this area consist of stone and rubble armoring in high intertidal areas, transitioning to Bay sediments at varying depths.

3.1.2 Surface Water and Circulation Patterns

Bellingham Bay is part of a system of interconnected bays that exchange water with the Rosario Strait and ultimately the Pacific Ocean through a complex network of channels and passages (Figure 3-3). Collias et al. (1966), Shea et al. (1981), and Broad et al. (1984) have previously described the physical oceanography of Bellingham Bay. In addition, a recent study of inner Bellingham Bay currents was performed by Colyer (1998).

Watershed Characteristics

The Whatcom Waterway Area lies principally within the Whatcom Creek Watershed, near the Whatcom Creek mouth. Here, a salt water wedge migrates upstream with the progression of high tides.

The inner Bellingham Bay area is primarily influenced by the drainage from three watersheds. The largest is the Nooksack River Watershed, which drains approximately 1,500 square kilometers (km^2). All of the Nooksack flow does not, however, reach Bellingham Bay. Part of it enters Lummi Bay by way of the Lummi River. The Nooksack River is also the primary source of sediments to the bay, with an annual discharge of 650,000 cubic meters (m^3). The Nooksack River is influenced by anthropogenic factors that include agriculture and logging.

The Whatcom Creek Watershed drains an area of approximately 26 km^2. Whatcom Creek flows from Lake Whatcom through the City of Bellingham to the bay. The City occupies much of the watershed. Presently, Whatcom Creek is influenced by channelization, vegetation removal, and urban storm water runoff.

The Squalicum Creek Watershed drains an area of 65 km^2 via Squalicum Creek; this creek originates at Squalicum Lake and also flows through the City. The creek is influenced by channelization, vegetation removal, and urban storm water runoff. Five other smaller watersheds also contribute fresh water to Bellingham Bay.

Regional Bottom Currents

Most oceanic waters enter Bellingham Bay at depth through the northern end of Rosario Strait between Lummi and Vendovi Islands. Some water also enters through Bellingham Channel. Exchange of water to the west through Hale Passage is limited by a shallow sill. The residence time for water in Bellingham Bay is typically four to five days, but varies between one and eleven days.

The available data indicate that there is a net southward flow throughout Bellingham Bay at depth, largely resulting from the lateral and vertical spreading of the Nooksack River discharge. Overall, bottom currents are relatively consistent throughout the year and typically range from 0.2 to 0.3 m/sec. As described by Colyer (1998), deep current velocities typically range from 0.04 to 0.18 meters per second (m/sec) in the inner bay and can be as high as 0.40 m/sec. Based on generalized relationships between bottom current velocities and sediment re-suspension thresholds, bottom velocities above approximately 0.3 to 0.4 m/sec may be capable of re-suspending fine-grained sediments (i.e., silt and clay particles). Accordingly, inner Bellingham Bay appears to be primarily a net depositional environment, though periodic resuspension of sediments in the inner bay is possible, particularly in shallow-water areas where bottom velocities can be influenced by wave action. This interpretation is consistent with the predominance of fine-grained sediment textures throughout the inner bay, except in higher-energy shallow-water areas.

Relative to the inner Bellingham Bay area, bottom and near-bottom currents within the more protected Whatcom Waterway are slower, and typically range between 0.04 and 0.10 m/sec. The maximum bottom velocity reported by Colyer (1998) in this area is 0.16 m/sec. Thus, the Whatcom Waterway is also predominantly a depositional environment with even less resuspension of bottom sediments by ambient oceanographic currents.

Regional Surface Currents

Surface currents throughout Bellingham Bay vary primarily in response to wind stress (Shea et al., 1981). Winds over the bay are from the south or southwest during much of the year, typical of foul-weather low-pressure systems in winter months, resulting in the forcing of surface water toward the northern part of the bay with return flow along the shorelines of the Lummi Peninsula, Portage Island, and Lummi Island. Fair-weather winds from the west or northwest cause surface flow to the east and south along the eastern shoreline.

In response to seasonal wind forcing, both clockwise and counter-clockwise circulation patterns are set up in Bellingham Bay. The salinity distribution maps of Collias et al. (1966) delineate freshwater discharges from the Nooksack River. The brackish river plume sometimes exits the bay along the western shoreline near Lummi Peninsula and Lummi Island (counter-clockwise circulation), but at other times exits primarily along the eastern shoreline near the City of Bellingham and Post Point where it is then directed southwestward across the bay toward the southern tip of Lummi Island (clockwise circulation). In both configurations, surface water enters Rosario Strait mainly near the southern tip of Lummi Island and Vendovi Island. The compensating inflow of seawater to the Bellingham Bay occurs partly via surface waters along the opposite shoreline from the brackish river plume and partly via bottom waters.

Typical surface currents range between 0.02 to 0.06 m/sec in the inner bay, reaching maximum velocities of 0.36 m/sec. Within the Whatcom Waterway, currents typically range from 0.04 to 0.06 m/sec. Maximum surface velocities exceeded 0.4 m/sec (Colyer, 1998).

Currents in the Whatcom Waterway Area

Surface water and deep water circulation patterns in the vicinity of the Whatcom Waterway Site have been developed from the data of Colyer (1998). Circulation patterns are very transient, changing quickly over the tidal cycle, and further complicated by the influence of discharge from Whatcom Creek. Nevertheless, some consistent patterns can be discerned.

The circulation within Whatcom Waterway appears to be typical of a two-layer estuary with discharge to the bay of brackish, riverine water at the surface and recharge into the waterway of saline marine water at depth. Thus, the surface water layer is dominated by seaward flow out of the waterway, and the deep water layer is dominated by landward flow into the waterway, although tidal currents may overwhelm this general pattern. The currents in the inner bay, both shallow and deep, are dominated by east-southeasterly along-shore flow. However, the influence of freshwater discharge or ebbing tidal currents from the Whatcom Waterway creates transient and complex counter-currents, eddies, and shear zones in the inner bay, and displaces the southeasterly ambient flow field farther into the bay.

Tides, Flooding, Storm Surge and Tsunamis

The mean tidal range within Bellingham Bay is 5.2 feet. The typical diurnal tidal range is about 8.6 feet. Flooding, storm surge, and tsunamis (in decreasing order of probability of occurrence) may increase the water levels in Bellingham Bay on rare occasions. Information on flooding in the Whatcom Waterway is obtained from the Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRMs) for Bellingham (FEMA, 2004). FIRM Panel 1213D shows a base flood elevation at the mouth of Whatcom Creek of 8 feet (National Geodetic Vertical Datum 29). This elevation represents a conservatively high 100-year flood elevation of between 12 and 13 feet above MLLW.

Empirical estimates of storm surge are obtained by subtracting the highest observed tide on January, 5 1975 from the predicted tide for that day. The predicted high tide as obtained from NOAA (per Nobeltec, 2004) for 5

January 1975 was 9.6 feet. The actual measured high tide was 10.4 feet above MLLW. The difference is a storm surge of 0.8 feet. The effects of storm surge on final water elevations vary with wind speed, wind direction, and tidal cycle (e.g., storm surges only produce extraordinary water elevations if they occur coincident with a high tide that is already near the maximum for the water body).

Tsunami inundation for Bellingham Bay is given by Walsh et al (2004). In the Whatcom Waterway Site area, the tsunami depth of inundation is estimated to be between 0 and 0.5 m (0 to 1.6 feet) based on the modeled seismic event. If a tsunami were to occur, this inundation depth would be added to the water elevation in the bay at that time. This means that the water elevation in the site area may increase by up to 1.6 feet above the tidal elevation at the time. This assumes that the tsunami occurs independently from either flooding or storm surge.

Salinity, Temperature, and Total Suspended Solids

In the top 30 feet of the water column, salinity varies with depth and over time. The observed variability is primarily the result of fresh water input, wind-induced circulation, and wind-induced mixing. Because most fresh water comes from the Nooksack River, brackish water (salinity less than about 26 parts per thousand [ppt]) is most extensively distributed in the upper part of Bellingham Bay, but a lower salinity surface layer has been observed to extend throughout the bay and south of Post Point. This surface layer is typically less than 6 feet thick, but high winds may occasionally deepen the surface layer to 12 feet. The deepest waters in Bellingham Bay are similar in character to those of Rosario Strait. Bottom water salinities typically range from 29 to 31 ppt, and are relatively stable throughout the year.

Colyer (1998) recorded surface salinities in inner Bellingham Bay ranging from approximately 10 to 25 ppt. Colyer also observed higher surface salinities during the incoming tide, and recorded deep water salinities in the inner Bellingham Bay area in the range of 26 to 30 ppt.

Water temperatures in Bellingham Bay vary with depth and over time primarily as the result of seasonal air temperature changes. Water temperatures range from 8 to 13 degrees Celsius (ºC) and are warmest in the summer and early fall and coldest during winter and spring.

The concentration of total suspended solids (TSS) within the inner Bellingham Bay area was recently measured by Colyer (1998). Surface water TSS concentrations ranged from 3 to 25 milligrams per liter (mg/L). Deep water TSS concentrations were similar and ranged from 1 to 32 mg/L. TSS concentrations averaged approximately 10 mg/L in both surface and deep waters.

3.1.3 Area Groundwater Studies

Groundwater in the vicinity of the Whatcom Waterway Site generally discharges to surface waters of Bellingham Bay, or Whatcom Creek. Groundwater patterns and water quality in the area have been extensively studied as part of area environmental and geotechnical studies.

Central Waterfront Groundwater Studies

Under Ecology's Voluntary Cleanup Program, the Port conducted an environmental investigation of the former Roeder Avenue Landfill site. The preliminary draft RI/FS for the Roeder Avenue Landfill Site (RETEC, 2001) described generalized groundwater flow features within the Central Waterfront area, between the I&J Waterway and the Whatcom Waterway. Key observations from that study included the following:

- Groundwater is predominantly present as a shallow unconfined layer within shallow fill material and underlying native sandy soils. The fill/sand layer varies from approximately 15 feet to over 40 feet in thickness. Silty clay soils of the glacial marine drift are located beneath the sandy soils and these soils do not contain significant water-bearing zones. The depths to bedrock are over 100 feet below ground surface in most of the Central Waterfront area.

- Groundwater in the Central Waterfront area consists of groundwater flow from across Roeder Avenue and infiltration from precipitation within the Central Waterfront area. Some water is also generated from seepage from the ASB.

- Gradients are generally toward the I&J and Whatcom Waterways, with the exception of the area near the ASB where gradients are affected by the ASB.

- Groundwater discharges in shoreline areas are subject to significant tidally-influenced mixing. This mixing is greatest in the area within 100 and 200 feet of the shoreline.

The study also included three-dimensional groundwater flow modeling for the Central Waterfront area, groundwater quality testing and a source control analysis. Groundwater was determined not to represent a sediment source control problem, provided that appropriate institutional controls were applied as part of the cleanup of the Central Waterfront site.

The information in the preliminary draft RI/FS for the former Roeder Avenue Landfill site will be included in a future public review draft RI/FS for the Central Waterfront site. The Central Waterfront site is comprised of four historically separate cleanup sites: the Roeder Avenue Landfill site, the

Chevron site, the Colony Wharf site, and the Olivine Uplands site. These individual sites have been combined into a single site by Ecology to comprehensively address commingled groundwater contamination.

Chlor-Alkali Plant Groundwater Studies

With Ecology oversight groundwater studies have been performed as part of the investigation of the Chlor-Alkali Plant site located east of the Bellingham Shipping Terminal. Those studies included measurements of area stratigraphy and groundwater gradients, testing of groundwater quality and completion of a sediment source control analysis (ENSR, 1994; Aspect, 2004; Anchor, 2001a).

Groundwater within the Chlor-Alkali Plant site is generally present in shallow fill soils and underlying native sandy soils. These soils are underlain by glaciomarine drift and bedrock of the Chuckanut sandstone formation. The depth to bedrock varies from less than 40 feet to over 100 feet, and generally increases offshore toward the Whatcom Waterway. Groundwater gradients are generally offshore toward the Whatcom Waterway. Gradients are affected by shoreline conditions and localized features.

A sediment source control analysis was included as part of the Engineering Design Report for the Log Pond Interim Remedial Action (Anchor, 2001a). That analysis indicated that groundwater discharging to the Log Pond is unlikely to cause sediment recontamination. Monitoring of sediment pore-water has been included in the monitoring program for the Log Pond cap. Recent pore-water monitoring data confirm the findings of the source control analysis. Mercury levels in groundwater discharging to the Log Pond have been below applicable surface water quality criteria and source impact levels (Appendix I).

Further evaluation of soil and groundwater conditions will be performed as part of the investigation and cleanup of the Chlor-Alkali Plant site.

Cornwall Landfill Area Groundwater Studies

Groundwater studies have been performed as part of ongoing investigation and cleanup actions at the Cornwall Avenue Landfill and RG Haley sites. The findings of the Cornwall studies were documented in a preliminary draft RI/FS (Landau, 2003). RG Haley site information is contained in the preliminary draft RI/FS (GeoEngineers, 2006). The Cornwall Avenue Landfill and RG Haley sites are in the RI/FS stage of the MTCA cleanup process with Ecology and public review drafts of the RI/FS are anticipated to be released in late 2006 or early 2007. Work performed to date indicates that there is no overlap between these sites and the Whatcom Waterway Site.

The Cornwall Avenue Landfill site includes municipal solid waste, overlying a layer of wood waste and sandy soils. Chuckanut sandstone is present at depths between 15 and over 70 feet below ground surface. Groundwater generally flows offshore toward Bellingham Bay. Nearshore groundwater discharges have been monitored directly using groundwater wells and intertidal seep monitoring. The cleanup of this site will be performed after finalization of the RI/FS and will address potential ongoing sources of contamination to surface water and site associated sediments.

At the RG Haley site, soil and groundwater at this upland contaminated site contain concentrations of pentachlorophenol, petroleum, and associated constituents. In 2001, a visible release of contamination from the site into Bellingham Bay was controlled through the installation of a barrier wall and a product recovery system. The temporary contaminant recovery system continues to operate. An RI/FS is being conducted at the site by the upland property owner, Douglas Management, under an Agreed Order with Ecology. The cleanup of this site will be performed after finalization of the RI/FS and will address potential ongoing sources of contamination to surface water and site-associated sediments.

3.1.4 Sediment Physical Properties

The physical properties of Bellingham Bay sediments have been characterized during RI/FS investigations and pre-design studies. RI/FS sampling locations are shown in Figure 3-4. That figure also shows the locations of testing performed adjacent to the Colony Wharf property on behalf of Ecology (Appendix F), in studies parallel to the RI investigations. The Colony Wharf sampling data are incorporated for completeness, as this area is being addressed as part of the Whatcom Waterway Site.

Surface Sediment Grain Size

Visual descriptions and grain size analysis information from RI/FS sampling locations were compiled to describe generalized sediment distribution patterns. Figure 3-5 illustrates the general distribution of fine-grained sediment (percent by weight less than No. U.S. 230 sieve size) from RI/FS data.

In general, the surface (0 to 12 centimeters [cm]) sediment grain size distribution in the deepwater portions of the Whatcom Waterway Site area consists of fine-grained materials. Coarser sediments are noted in higher-energy shallow-water areas. This pattern is likely a function of water depth, with higher wave energies impinging on the bottom in shallow water and winnowing out the finer sediments. The grain size distribution in the I&J Street Waterway is similar and grades from coarser at the head of the waterway to finer near the mouth. Surface sediment samples outside of the main waterway channels generally consisted of clayey silt to slightly sandy, very clayey silt with sandier material located near the intertidal banks.

Wood Material Distribution

Figure 3-5 also summarizes the areas where woody material was identified in the upper 1 foot of sediments during 1996 sediment investigations. The areas were localized in former log rafting areas, and in the Log Pond.

ASB Sludge and Berm Materials

The ASB sludges consist of wastewater solids containing mixtures of pulp solids, wood chips, ash, and microbial biomass. The materials are characterized by low solids content, averaging 17 percent by weight. The total organic carbon content of the sludges is also very high, averaging 33 percent. The sediment grain size varies with location and depth, ranging from relatively coarse material (18 percent fines) to very fine material (greater than 96 percent fines). Excluding the bentonite lining and the ASB sludges, the ASB berms consist of armor stone and sand material. A typical cross-section through a portion of the ASB berm is shown in Figure 3-6.

Sediment Organic Carbon

The distribution of total organic carbon (TOC) content in surface sediment ranges from 0.82 percent (HC-SS-48) to 13.0 percent (AN-SS-305). Most of the samples contained TOC concentrations between 2 and 4 percent, with an average concentration of 3.2 percent. The highest concentrations of TOC were noted in sediments containing woody materials.

Subsurface (0 to 20 feet) sediment TOC concentrations within the site sediments ranged from a low of 0.16 percent to a maximum of 49 percent (HC VC 77 S2; 2.1 to 3.9 feet depth). The average TOC concentration in subsurface sediment in remaining site remediation areas is 4.3 percent. In general, elevated TOC concentrations correlated with the presence of wood materials in the subsurface.

Subsurface Sediment Physical Properties

Throughout most of the site, core samples of subsurface sediments encountered clayey, very sandy silt. This silt layer is dominant in deepwater depositional areas and in portions of the waterway that were historically dredged and have accumulated recent sediment deposits.

In shallower water areas and certain under-pier areas, the mean sediment type for under-pier sediments is a slightly gravelly, slightly clayey, silty sand. The distribution of subsurface sediment textures varies with the wave energy environment and is also influenced by native subsurface geologic patterns and patterns of historic dredge and fill activity. Sediments beneath the ASB and adjacent offshore areas consist predominantly of sandy sediments.

Some geotechnical testing has been performed on sediments from the site. Observations from these tests include the following:

- **Atterburg Limits:** Atterberg limit analyses were completed on ten selected cohesive core samples representing a variety of depths and locations. Atterberg limits, which include the liquid limit, plastic limit, and the plasticity index, were used to define plasticity characteristics of clays and other cohesive sediments. These results help define dredgability and compression properties of fine-grained sediments. The majority of cohesive samples were classified as a medium to high elastic silt or clay. Two samples (HC-VC-72-S4 and HC-VC-79-S4) were classified as clay with low plasticity. These samples are from the compact Glacial Marine Outwash unit.

- **Sediment Density:** Profiles of sediment density were determined for the natural recovery cores HC-NR-100, HC-NR-101, and HC-NR-102 (Figure 3-5). Sediment wet density was calculated using an empirical formula derived by Battelle (1995) for sediment compositions typical of Puget Sound. This formula relates the percent dry weight of sediments to the wet density through the following equation:

  Wet density = 0.1737(5.0245 + e0.0238 x percent dry weight)

  Sediment wet density calculations were volumetrically corrected for compaction compression which occurred during coring. Average surface (0 to 2 cm) wet density in inner Bellingham Bay ranged from approximately 1.23 to 1.30 grams per cubic centimeter (g/cm^3). Wet density increased with depth in the cores to a maximum of approximately 1.32 to 1.42 g/cm^3 at a depth of 1 meter below the mudline.

3.1.5 Sediment Lithology

The subsurface geology of the Whatcom Waterway Site area is complex, due to the large site area, natural variations in subsurface geologic conditions, and the results of anthropogenic changes to waterway conditions over the last century. The discussion below is based on RI/FS investigation findings, historical and current bathymetry maps, dredging histories for the waterways, and upland borings and reports from area environmental and geotechnical studies.

Waterway Area Lithology

The sedimentary sequence within the site sediments is a function of fluvial sediment loads, deltaic growth rate, and the local depositional environment. A rapidly advancing delta front is characterized by an abundance of sands. Slower growth periods are characterized by finer grained sediments, principally silts, being deposited in lower energy environments. The distributary channels within a delta also meander and shift, resulting in erosion and channel backfilling. Discharges from the Nooksack River, Whatcom Creek, and Squalicum Creek all contribute to the WW Area sediment profiles, which commonly display sediment stratigraphy consisting of inter-layered sands, gravelly sands, silty sands, and sandy silts.

The natural depositional environment of the waterway has been altered by dredging (including excavation of the original waterway,) maintenance dredging, and fill replacement during nearshore construction. Excluding the ASB structure and accumulated sludges, the waterway area sediments can be divided into the following major sediment units (Figures 3-7 through 3-9):

- **Post Dredge Recent Deposits:** Recent deposits consist primarily of very soft, brown-black, slightly sandy, clayey silt with shell fragments and varying amounts of wood debris overlying a soft, dark gray silt with trace wood fragments. The thickness of the recent deposits varies between less than 1 and over 7 feet. In some cases the physical sequences of the sediments have been disturbed, for example by the trenching and backfilling of the G-P pipeline installation in 1979, or by shoreline erosion along the Central Waterfront shoreline. The post-dredge recent deposits contain the majority of the impacted sediments. Mercury concentrations in these sediments are consistently cleaner in the surface sediment, than in underlying sediments as shown on Figure 3-7. This pattern is the result of natural recovery, through deposition of clean sediment over the top of historic, impacted sediments.

- **Post Glacial (Pre-Dredge) Fluvial Deposits:** This unit consists of medium dense, gray, non-silty to silty, fine to medium sand with multi-colored grains, shell fragments, and occasional gravel and silt lenses grading to gray silt with clay. Deposits are coarser near the head of the waterway, described as slightly gravelly sand with shell fragments. This unit represents native fluvial sediments, primarily from Whatcom Creek, deposited prior to the deepest dredging event and prior to industrialization of the area. The base of this sand unit is gradational in nature but generally occurs at an elevation of approximately 22 feet above MLLW near the head of the Whatcom Waterway and deepens to an elevation of 36 feet near the mouth of the Whatcom Waterway. In the I&J Street Waterway, the base of the sand unit ranges from elevation 22 to 25 feet below MLLW. The base of the sand unit is at elevation 40 feet below MLLW near the 1979 pipeline trench.

- **Glacial Marine Drift:** The third major unit is a stiff to very stiff, damp to moist, gray, silty clay to clay with scattered gravels and occasional fine to medium sand layers. The drift was encountered at elevations ranging from 28 feet below MLLW near the head of both waterways to 50 to 60 feet below MLLW near the mouth of the waterways. This glacial outwash unit was confirmed by adjacent upland borings advanced through fill, lagoon silts, alluvial sands, and then into glacial sequences. Anthropogenic Changes to Waterway Area

Lithology

The waterway dredging history was summarized as part of the development of the RI/FS Work Plan (Hart Crowser, 1996b). Additional changes to area lithology are associated with nearshore filling, shoreline infrastructure construction and the development of the ASB. Major events affecting lithology in the site area include the following:

- **Early Waterway Dredging and Filling:** The Whatcom and I&J Street Waterways were identified on state land maps as early as 1891. Early dredging activities in the Whatcom and I&J Waterway areas included dredging of shallow channels, with side-casting of the dredge materials behind bulkheads for creation of shoreline fill areas. Portions of the Central Waterfront and GP mill site areas were filled in this manner.

- **Whatcom Waterway Dredging:** The initial Whatcom Waterway channel was authorized in 1902 and was dredged by the Corps to a width of 200 feet and a depth of 12 feet below MLLW. A wider, deeper waterway was authorized for dredging by the River and Harbors Act of June 15, 1910. At that time the Port operations were conducted by the City of Bellingham. The dredging of the 1910-authorized channel was completed in 1913, with an Inner Waterway channel depth of 18 feet below MLLW and an Outer Waterway depth of 26 feet below MLLW. The federal channel dimensions were modified in 1958 by the Harbor Act of July 3, 1958. That modification shortened the 18-foot channel section, increased the Outer Waterway authorized depth from 26 feet to 30 feet, and precluded federal dredging activities within 50 feet of the pierhead lines. Dredging events were performed in 1961 and 1969. Most of the berth areas at the head of the Inner Waterway were never upgraded to comply with the new channel dimensions. The Starr Rock sediment disposal site was used during the 1969 dredging activities. Additional localized dredging events were performed in 1974 and 1979. Sediments generated during the 1974 dredging event were placed in a confined disposal facility at the Chlor-Alkali Plant site. Dredge depths varied from project to project, depending on the methods used and the objectives of the project.

- **I&J Waterway Dredging:** The I&J Waterway was initially dredged to depths of approximately 12 feet below MLLW in the early 1900s. The federal channel in that waterway was authorized in May of 1965, with a project depth of 18 feet below MLLW. The federal dredging of the I&J Waterway was completed in 1966, with subsequent dredging by the Corps in 1992 in selected areas.

- **Central Waterfront Shoreline Changes:** The Central Waterfront shoreline was initially created during early development of the Whatcom Waterway. The shoreline was subsequently reconstructed in places to replace or upgrade bulkheads and wharf structures. The shoreline infrastructure was never upgraded to support the deepening of the federal navigation channel in 1961. Since that time the shoreline infrastructure has generally deteriorated, with shoaling of berth areas, collapse or rupture of certain bulkheads and collapse of some over-water wharf structures.

- **Filling near the Port Terminal:** The Bellingham Shipping Terminal area was filled between 1920 and the 1990s using a variety of materials. These included sediments dredged to create the Log Pond area, sediments dredged from the Whatcom Waterway and Barge Dock areas, imported soils generated during construction of Interstate 5 near Lake Samish, and soils imported from other upland sites. The docks and wharves of the terminal area have been upgraded and replaced periodically since the early 1900s.

- **Filling at the GP Mill Site:** Filling activities at the GP site have included placement of dredge materials and imported soils. The last major fill event there included the placement of dredged materials in a confined disposal facility adjacent to the Log Pond in 1974.

- **Filling Along the Cornwall Area Shoreline:** The shoreline area near the Cornwall and RG Haley sites was filled initially during operation of the Bellingham Bay Improvement Company lumber mill in the late 1800s and early 1900s, and the later Bloedell Donovan Lumber Mill through the mid 1940s. Filling at the Cornwall Landfill site included placement of municipal solid waste between 1953 and 1965 by the City of Bellingham. Soil fill was placed at the RG Haley site during the 1950s and early 1960s. Armor materials were placed along the shorelines of both sites during the 1970s and 1980s to control shoreline erosion. Additional erosion control materials were placed at the RG Haley site as part of the Interim Remedial Action there.

- **ASB Construction:** The ASB was constructed in 1978 and 1979, along with installation of wastewater pipelines beneath the Whatcom Waterway, and installation of an outfall line offshore of the ASB. Dredging activities included excavation of trenches for the pipeline crossing and outfall line, and dredging of the ASB basin to a minimum neat-line depth of 12 feet below MLLW. Berm construction included placement of imported stone and sand materials, placed as shown in Figure 3-6.

As discussed in Section 5, the vertical extent of chemical contamination at the Whatcom Waterway site varies with location. The above-listed anthropogenic changes to area lithology, bathymetry and shoreline composition has affected the locations and thicknesses of the post-dredge recent sediments that contain elevated contaminant levels.

The depth of chemical contamination below mudline ranged from less than 2 feet at the mouth of the Whatcom Waterway to 9 feet in the Log Pond. While site conditions vary with location, the following represent generalized estimates of the thicknesses of the recent sediment deposits:

- Outer Whatcom Waterway (offshore of BST): 1 to 3 feet below mudline

- Inner Whatcom Waterway (between BST and Laurel Street): 3 to 6 feet below mudline

- Head of Whatcom Waterway (between Laurel Street and Roeder Avenue): 5 to 8 feet below mudline

- Log Pond (prior to interim remedial action): 6 to 9 feet below mudline

- I&J Street Waterway: 2 to 6 feet below mudline.

ASB Area Lithology

The following paragraphs document the subsurface stratigraphic units encountered within the ASB during the exploration program. Figure 3-6 provides an interpreted geologic cross section through the ASB and adjacent site areas and depicts the relative thickness of each unit at the exploration locations. Site characteristics at locations between explorations were based on interpolation.

- **ASB Berm Structure:** The ASB berm structure was constructed in 1978 under an Corps Permit. The berm is a composite structure of stone and sand, with surface dressings of asphalt and bentonite clay. The outer core of the berm consists of various grades of stone. The stone core was constructed on top of the former tidelands and extends to a height of 16 feet above MLLW in most areas. A thick sequence of imported sand material is present along the inside of the berm, extending upward to elevations of 22 to 24 feet above MLLW. This sand is covered on the outer edge by armor stone. The inner portion of the berm is covered by dressings of asphalt (16 to 24 feet above MLLW) and bentonite clay (elevations below 16 feet above MLLW) to reduce berm permeability and protect against wave-induced erosion.

- **ASB Sludges:** The ASB sludge consist of surface and near-surface secondary sludge deposited since 1979 as part of the operation of the ASB for wastewater treatment. These materials were identified as olive green to gray, very soft, highly organic silt-sized materials, with total solids averaging 14 percent and high TOC content typically between 30 and 50 percent. The base of the ASB sludge layer was assessed by probing and coring and averaged just over 14 feet below MLLW, (Appendix D) consistent with the historical dredging of the basin in 1978.

- **Limited Recent Sediment Deposits:** In most areas of the ASB, recent sediments were removed by dredging in 1978, as part of the construction of the ASB facility. Dredging was conducted in order to provide for ASB volume capacity. Recent sediments may be present in a thin layer beneath portions of the berm structure. The dredging established a target neat-line elevation of 12 feet below MLLW, with one to several feet of over-dredging. Because of this dredging, recent sediment deposits are not present throughout the main ASB area and sequences transition rapidly from ASB sludges to post-glacial fluvial deposits.

- **Native Post Glacial Fluvial Deposits:** Underlying the recent deposits is the Fluvial Deposit unit, which consists of native medium dense, gray, non-clayey to clayey, fine to medium sand with multi-colored grains, shell fragments, and occasional gravel and clay lenses grading to gray silt with clay. Total solids range from approximately 70 to 91 percent in the Fluvial Deposits. This native unit ranges from 8 to 22 feet thick within the footprint of the ASB.

- **Native Glacial Marine Drift:** Underlying the native post-glacial fluvial deposits is a deposit of glacial marine drift, which is a stiff to very stiff, damp to moist, gray, silty clay to clay with scattered gravels and occasional fine to medium sand layers. Results from lab tests indicate that this unit is a lightly to moderately over-consolidated lean clay, with total solids ranging from approximately 60 to 90 percent. The native Glacial Marine Outwash layer was the deepest unit encountered during the exploration program. The top elevation of this unit ranged from 25 to 36 feet below MLLW, and slopes generally from north (shallower) to south and southwest (deeper). Based on area geotechnical studies, Chuckanut sandstone is known to underlie the marine drift layer at depths in excess of 100 feet below MLLW.

3.2 Natural Resources

This section summarizes information on natural resources in the Whatcom Waterway Site area, including fish and wildlife, existing habitats, and plant and animal species.

3.2.1 Types and Functions of Habitats

Detailed information on Bay-wide habitat conditions and habitat maps can be found in the Data Compilation Report (Pacific International Engineering and Anchor Environmental, 1999). Most of the habitats in Bellingham Bay are used by a variety of marine and terrestrial species for feeding, reproduction, rearing, and refuge. The Whatcom Waterway specifically hosts various benthic macroinvertebrates (bivalves, crabs, polychaetes), as well as providing habitat or passage for various fish species (both bottom fish and pelagic species such as salmon).

The different elevations of habitat are discussed below in three groups: intertidal, shallow subtidal, and subtidal. Although separated by only a few feet, these three strata have distinct soil textures and support varying plant and animal communities. Each stratum has two types of substrata: sand/mud/ cobble and gravel/rocky shore. The habitat typically found in these strata is summarized here to preface more detailed descriptions of fish and wildlife habitat in the Bay.

- **Intertidal: 4 feet below to 11 feet above MLLW**
  - **Sand/mud/cobble.** This area supports rooted plants to varying degrees, with increased numbers and variety occurring at higher elevations. Native eelgrass is most commonly found at 0 to 4 feet below MLLW, while rushes, sedges, and pickleweed can be found at 11 to 8 above MLLW. These plants provide food and refuge to various organisms, including juvenile salmon, shrimp, crab, and flat fish. Mudflats found in this substratum support epibenthic prey that are consumed by juvenile salmon migrating through the area. Pacific herring may also use the eelgrass and macroalgae found in the intertidal zone as spawning habitat. The finer substrate at

higher elevations (8 to 11 feet above MLLW) provides spawning habitat for sand lance and surf smelt. Intertidal habitat of this kind is limited in the Whatcom Waterway area to areas at the head of the Whatcom and I&J Waterways, areas along portions of the sides of the Whatcom Waterway, in beach areas at the foot of Hilton Avenue and at the foot of Pine Street and in portions of the Log Pond following completion of the Interim Remedial Action.

- ► **Gravel/rocky shore.** Native eelgrass is occasionally found in pools and channels on the rocky shores at about 0 feet MLLW. Brown, green, and red algae are also found throughout this area. The higher elevations of this substratum are affected by higher tides; plant material can consist of lichens, some flowering plants, and leadwort. Animals commonly encountered include crabs, shrimp, sponges, sea anemones, worms, sea stars, oysters, and various fish (e.g., perch, prickleback, flat fish, and some juvenile salmon). Fish use this area for feeding, refuge, and reproduction. Armored and rocky areas of the Whatcom Waterway with this type of habitat are located along the sides of the Whatcom and I&J waterways, along the shoreline of the ASB, and in portions of the Log Pond.

- **Shallow Subtidal: 4 to 10 feet below MLLW**

  - ► **Sand/mud/cobble.** The plant and animal communities and functions in this substratum are similar to those described in lower elevations of the intertidal habitat; a notable exception is native eelgrass, which is typically more common within the -4 to 10 feet below MLLW zone. Mudflats within this substratum support epibenthic prey that is consumed by juvenile salmon migrating through the area. The substrate within this elevation can also provide suitable habitat for Dungeness crab mating and egg brooding. Shallow subtidal areas are located at the heads and along portions of the sides of the Whatcom and I&J waterways, in areas at the foot of Hilton Avenue and Pine Street, in the shoulder of the ASB and in the Log Pond.

  - ► **Gravel/rocky shore.** Native eelgrass is occasionally found in this area, as are a variety of brown, red and green algae. Animals common to this substratum include crabs, shrimp, sponges, sea anemones, worms, sea stars, oysters, and a variety of fish such as perch, prickleback, flat fish, and some juvenile salmon. The fish use this area for feeding, refuge and reproduction. Rocky shallow subtidal habitats are located along portions of the Whatcom and I&J Waterways and along the shorelines of the ASB and in portions of the Log Pond.

- **Subtidal: Greater than 10 feet below MLLW**

  - **Sand/mud/cobble.** Native eelgrass is still relatively common between 10 and 20 feet below MLLW; however, beyond 20 feet below, light is limited and eelgrass and macroalgae are less prevalent. Some varieties of hard-shell clams are also less abundant with increased depth, while the geoduck clam tends to be more abundant in deeper water. The substrate within this elevation can provide suitable habitat for Dungeness crab mating and egg brooding. The substrate and water column are also used for feeding by a variety of fish, including sub-adult and adult juvenile salmon. Most portions of the Site consist of subtidal habitat with sand or mud bottom.

  - **Gravel/rocky shore.** Larger-sized fish and shellfish often occur in deeper waters. Greater than 20 feet below MLLW, light reaching the sea floor limits the abundance and growth of macroalgae. In addition, the occurrence of some species such as oyster is rare. Rocky subtidal shorelines within the site predominantly occur along the developed shorelines of the Whatcom and I&J Waterways. Some rocky outcroppings occur at subtidal elevations at Starr Rock.

Portions of the Whatcom Waterway Site area have been developed for navigation uses with infrastructure improvements. This infrastructure affects the types of habitat conditions that are present in these areas. Other than depth modifications (i.e., dredging) the main types of navigation infrastructure that exist in the Whatcom Waterway Site area include bulkheads, armored slopes, and over-water structures. Habitat considerations associated with these features are described below:

- **Bulkheads**: The term bulkhead refers to constructed sheer vertical walls that stabilize the shoreline. Typically they are concrete or metal sheet pile, although many older bulkheads are constructed from treated timber. In the Whatcom Waterway, bulkheads are a common feature in the intertidal zone. Most extend from above mean higher high water to the structure design depth (varies from mean lower low water to depths greater than 10 feet below MLLW depending on the required water depth at the face of the bulkhead). Bulkheads are often installed in conjunction with armored slopes below the toe of the bulkhead. A bulkhead yields a habitat with no depth variability and no horizontal surfaces to support primary production, secondary production, or processing of detritus. While sessile organisms, including barnacles and some macroalgae, can attach to the vertical bulkheads, it is not suitable for producing epibenthic prey organisms for juvenile salmon. The vertical slope also means that juvenile salmon using the top one to two meters of the water column are in much deeper water during most or all tidal cycles, depending on the bottom elevation of the bulkhead, compared to a naturally sloping nearshore area. This may increase their susceptibility to predators. Juvenile salmon use waters adjacent to bulkheads, and can forage on prey items derived from planktonic or neustonic sources. However, due to the lack of epibenthic organisms, overall prey resources are typically considered to be reduced relative to sloped habitat.

- **Armored Slopes:** Slopes armored with large stones or "riprap" are typically steep and compress the horizontal habitat profile yielding less habitat within the desired zones for juvenile salmonids than do more gently sloped habitats. Unlike bulkheads, the resulting habitat does have surfaces to support primary productions, secondary production, and processing of detritus. Substrate size of riprap slopes differs from the fine silts or sands that would have been typical of the depositional delta area in the historic Whatcom Creek, or even more coarse gravel or cobble substrates farther from the mouth of the creek. At elevations that are exposed to regular, significant wave energy, riprap has essentially no ability to retain water or organic material on its own, except in depressions in individual pieces. Exposed rock surfaces at these elevations eventually develop sessile biological matrices, including macroalgae and invertebrates, which reduce desiccation at small scales and allows for an assemblage including mobile invertebrates. At lower elevations that do not have significant wave exposure, riprap can provide a suitable substrate for many different species of macroalgae and also provides habitat areas in its interstices for invertebrates. A common means of improving the productivity of riprap slopes is to fill the interstices of the rock with a finer material (e.g., gravel) that can increase both water and organic material retention, and increase the ability of the bulkhead slope to support an assemblage include juvenile salmon prey organisms. This method may not be appropriate in higher energy areas where substrate may not be retained at mid and higher elevations. The biological assemblages on riprap substrate are more comparable to that of a rocky nearshore area than beaches. While there are epibenthic prey available for juvenile salmon in these areas, habitat function is reduced compared to areas with smaller substrate. Juvenile salmon use waters adjacent to riprap and can forage on prey items derived from planktonic or neustonic sources as well as the limited epibenthic prey.

- **Overwater Structures:** Intertidal and shallow subtidal shading has decreased light levels underneath and around overwater structures. Shading is of primary concern because it reduces light available for photosynthesis by aquatic vegetation. Reduced primary productivity has implications both in terms of habitat structure and complexity (reduction or loss of aquatic vegetation), and in terms supporting productivity elsewhere in the food web, including juvenile salmon prey organisms. Shading impacts extend beyond the structural footprint of the structure as the sun's movement across the sky over a day or season results in a larger shaded area as it is oriented in different aspects. Small structures, such as narrow piers, shade relatively less area than large or wide structures such as pier aprons. Depending on the orientation of the narrow structure, direct sunlight can reach most the shade footprint over the course of a day or season. The distance from the lighted edge to the center of the structure footprint is also relatively smaller than at a wider structure, resulting in higher levels of ambient light. In contrast with wide structures, large proportions of the shade footprint may never receive direct sunlight. Wider structures also decrease the ratio of lighted edge to shaded area, and increase the distance from the lighted edge to the center of the structure footprint. This results in less ambient light under wider structures and therefore more intense impacts associated with shading. This has implications for productivity and can reduce the habitat function of an area for juvenile salmon foraging. Nearshore habitat function may be reduced underneath and immediately adjacent to overwater structures. For juvenile salmon, this impact is relatively greater at the typically highly productive low to middle intertidal zone, although impacts on macroalgae in the shallow subtidal and salt tolerant plants in the supratidal splash zone also can affect productivity in these zones. As with bulkheads, foraging function around overwater structures may be reduced due to decreased productivity but alternative food sources (plankton, neuston) are available. Those juvenile salmon that move into deeper water to avoid overwater structures may be more susceptible to deeper water predators, but this behavior is not always the response to encountering a structure.

3.2.2 Plant and Animal Species

The Bellingham Bay area is utilized by a wide range of plant and animal species. Documented uses for significant plant and animal species are summarized below.

Fisheries and Invertebrate Resources

Documented fisheries resources for Bellingham Bay include the following:

- **Surf Smelt and Sand Lance:** Surf smelt and Pacific sand lance are common fish that spawn in the high intertidal portions of coarse sand and gravel beaches (WDF, 1992). Surveys by Washington Department of Fish and Wildlife (WDFW) have documented spawning beaches in Bellingham Bay. However, no surf smelt or sand lance spawning has been documented in inner Bellingham Bay, presumably because suitable substrates are not available.

- **Pacific Herring:** Pacific herring spawn in inland marine waters of Puget Sound between January and June in specific locations. There is typically a 2-month peak within the overall spawning season. Herring, which deposit their eggs on marine vegetation such as eelgrass and algae in the shallow subtidal and intertidal zones between 1 foot above and 5 feet below MLLW, are known to congregate in the deeper water of Bellingham Bay. However, only relatively low-density spawning deposition occurs in the Bay, and none of that has been documented in the vicinity of the Whatcom Waterway.

- **Salmonids:** Bellingham Bay is used extensively by anadromous salmon species (Shea et al., 1981). Each of the streams flowing into Bellingham Bay is used by one or more of the economically important species listed in Table 3-1. The Nooksack River has the largest salmon runs in Bellingham Bay, followed by Squalicum and Whatcom creeks. Concentrations of chum, coho, and chinook salmon along the shoreline and in offshore waters in Bellingham Bay peak annually about mid-May. Juvenile coho and chinook salmon appear to have different migration habits. Coho remain in the Bay for approximately 30 to 35 days, while chinooks remain about 20 days. More recent studies on the distribution of chinook salmon (Ballinger and Vanderhorst, 1995) indicate relatively high numbers of juvenile chinook salmon and average numbers of coho salmon use the area in the vicinity of the Whatcom Waterway.

- **Groundfish:** Several species of groundfish occur in both shallow and deep waters in Bellingham Bay for part or all of their life. Detailed information on groundfish species and their timing and use of Bellingham Bay is not available. Key characteristics of groundfish occurring in northern Puget Sound are generally applicable to Bellingham Bay.

Bellingham Bay supports a variety of marine invertebrates, ranging from infauna (worms, clams, and small ghost shrimp that penetrate benthic sediments) to epibenthic plankters (organisms such as very small crustaceans that move off the substrate surface) to larger invertebrates such as oysters, crabs, and shrimp.

- **Clams, Geoduck and Oysters:** The predominant bivalves in Bellingham Bay are intertidal and subtidal hard-shell clams. Intertidal shell clam types include butter, littleneck, horse, and soft-shell clams and cockles. Subtidal clam resources consist of butter, littleneck, and horse clams. Native oyster and Pacific geoduck are also known to occur in Bellingham Bay (Palm, 1995; WDF, 1981; WDFW, 1992; Webber, 1974). Shellfish densities are relatively low along the eastern shore of Bellingham Bay in the vicinity of the Whatcom Waterway, although bivalves are the dominant benthic organism within the Waterway (Anchor Environmental, 1999). Scattered oysters also occur along the shoreline of the Whatcom Creek estuary (Palm, 1995). Geoduck, which is only present in a handful of locations in the Bay, does not occur within the Whatcom Waterway.

- **Shrimp:** Seven species of pandalid shrimp, including, pink, coonstripe, dock, and spot shrimp, occur in nearshore and deeper waters of Bellingham Bay. For example, coonstripe shrimp have been observed in intertidal areas immediately offshore of the Cornwall Avenue Landfill (which is just south of the Whatcom Waterway), and this species is common around piers and floats. Shrimp densities in the areas surrounding the Whatcom Waterway are moderate when the Bay is viewed as a whole.

- **Crab:** Crab trawls conducted for the Puget Sound Dredge Disposal Analysis (PSDDA) investigations indicate that the predominate crab resources in Bellingham Bay are the non-edible purple or graceful crab, the edible red rock crab, and the edible Dungeness crab. The highest densities of rock crab occur in relatively shallow water (30 to 45 feet below MLLW) in areas extending from the Lummi Peninsula to inner Bellingham Bay. Rock and Dungeness crab are likely to occur in shallower waters of Bellingham Bay not sampled as part of the PSDDA investigations. Dungeness crab is generally abundant in most areas of Bellingham Bay, and has been documented in the Whatcom Waterway (Ecology, 2003). The northern and eastern shorelines of Bellingham Bay serve as nursery/rearing areas for juvenile Dungeness crab. A shell substrate is a preferred habitat for the first 8 to 10 weeks after larvae settle. However, other substrates, such as small cobbles and gravel, algae, and eelgrass, are also recognized as important rearing habitat for juvenile crab. Because the Whatcom Waterway has relatively limited quantities of these habitats, its usefulness as a nursery/rearing area is likely limited.

Table 3-1 Salmon and Trout Fisheries in Bellingham Bay

Species	Fishery
Coho	mid-September to mid-November
Chum	early November to mid-December
Chinook	late July to mid-September
Pink	July in odd years
Sockeye	no fishery
Steelhead	mid-December to January
Cutthroat	no commercial fishery
Bull trout	no fishery

Sea Birds and Marine Mammals

The greater Bellingham Bay area and its shallow estuarine habitats support a number of birds at all seasons. Although Bellingham Bay is not used extensively by large populations of waterfowl, wintering populations tend to be 10 to 15 times larger than summer populations for migratory species (Manual et al., 1979). The Bay is located on the flight path between the Fraser River estuary and Skagit Bay, and is used as a stopover for seabirds and waterfowl migrating between these two areas. Waterfowl sited in Bellingham Bay include brant, snow geese, mallard, widgeon, green-winged teal, and pintail. Bellingham Bay is also used as an over-wintering area for diving birds such as scoter and golden eye. A variety of both natural and man-made habitats provide protection from winter storms habitat to migrant and wintering birds.

Glaucous-winged gulls use inner Bellingham Bay for resting and foraging. Pigeon guillemonts use the shoreline area in and around the Whatcom Waterway for nesting and foraging. The Habitat Restoration Documentation Report (Pacific International Engineering, 1999) describes the individual bird species and their use of Bellingham Bay by season.

Limited information is available on the presence and residence time of marine mammals in Bellingham Bay (PTI, 1989). Bay-wide, several species have been reported: the harbor seal, sea lions, Orca whale, gray whale, and harbor porpoise. As described below, the local population of Orca whale is being listed as endangered under the Endangered Species Act (ESA). The other marine mammals are not threatened or endangered species under ESA, but they are protected from hunting under the Marine Mammal Protection Act. Seals and sea lions have been noted using the Log Pond and portions of the I&J Waterway for resting areas. Migrating gray whales have been noted to enter Bellingham Bay and to feed in subtidal areas of Puget Sound. Orca whales are occasionally observed in and near Bellingham Bay, though they are more typically observed in Rosario Strait and near the San Juan Islands.

Threatened, Endangered, Sensitive and Candidate Species

Under the ESA, a species likely to become extinct is categorized as "endangered." A species likely to become endangered within the foreseeable future is categorized as "threatened." This section provides information on the occurrence of threatened and endangered bird, fish and marine mammal species in Bellingham Bay.

- **Bald Eagle:** The majority of bald eagle nest sites occur in the eastern portion of Bellingham Bay, primarily in the Nooksack River delta along the shoreline and in inland areas of the Lummi Peninsula. There are also some nests along the shoreline of Portage Island and Chuckanut Bay. Nest trees in the Pacific Northwest are typically tall conifers located in forested or semi-forested areas within about 1 mile of large bodies of water with adequate food supplies. Marine and freshwater fish are eagles' preferred prey; birds contribute a smaller proportion of the eagle diet. Prey may also include small mammals. Nesting eagles generally forage within 10 square miles of their nest site. Thus, while the Whatcom Waterway vicinity does not appear to provide eagle habitat, it may serve as a food source. The bald eagle was proposed for delisting as of July 6, 1999 due to apparent recovery of the species in the U.S. (Federal Register 50 CFR Part 17). The bird is still be protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The United States Fish and Wildlife Service (USFWS) also works with state wildlife agencies to monitor the status of the species as required by the ESA.

- **Peregrine Falcon:** Peregrine falcons are also found in Bellingham Bay. They feed almost exclusively on birds captured in flight, particularly waterfowl, shorebirds, and game birds. Peregrine falcons typically nest on cliff ledges greater than 150 feet in height that are close to the water. The Whatcom Waterway has no documented Peregrine falcon nests.

- **Marbled Murrelet:** Open water concentrations of marbled murrelets have been recorded in the central portion of Bellingham Bay. Murrelets forage in the marine environment typically up to 2 miles near a coastline. The species forages year round in waters generally less than 90 feet deep, sometimes congregating in well-defined areas where food is abundant. These birds generally do not utilize shallower waters less than 30 feet deep. Marbled murrelets reportedly feed on a wide variety of prey, including sand lance, Pacific herring, and other marine taxa such as crustaceans. Murrelets require old growth or mature forest composed of conifers, including Douglas fir, western red cedar, Sitka spruce, and western hemlock. There are no known nest sites along the shoreline of Bellingham Bay, and no clear association between these birds and the Whatcom Waterway.

- **Salmon:** On March 16, 1999, the National Marine Fisheries Service (NMFS) added nine West Coast salmon to the Endangered Species List. Of the nine listed species, one occurs within the project area: the Puget Sound chinook salmon, which was listed as a threatened species. Two races of chinook salmon (spring and fall) are found in Bellingham Bay. The timing of adult migration to freshwater differs between these two races, but the timing of the return of adult fish, spawning, and emigration of juveniles overlap. Fall chinook is the most common run of chinook salmon observed in Puget Sound. Juvenile fall chinook generally emigrate to the estuary between February and August as sub-yearlings (within the first year after being spawned) or as yearlings. Individual fish may only use Bellingham Bay for a period of days to a few weeks before heading into the greater Puget Sound estuary. They may use the estuaries and intertidal areas between April and November for further rearing and growth. As juvenile fish move into neritic habitats, they preferentially consume emergent insects and epibenthic crustaceans in salt marsh habitat or decapod larvae, larvae, and other prey (Simenstad et al., 1991). Whatcom Creek and the Whatcom Waterway are utilized by salmon (Ecology, 2003), although the Whatcom Waterway serves more as a migration corridor between Whatcom Creek and the Whatcom Creek Estuary than nursery/rearing habitat given the lack of suitable substrate and refuge.

- **Bull Trout:** Bull trout, listed as a threatened species under the ESA by the USFWS, are a member of the North American salmon family. Bull trout occur in the Nooksack River, and presumably spend some time in Bellingham Bay. Many are resident to a single stream; others migrate on a fluvial (i.e., spawn in headwaters streams and live downstream in larger rivers) or adfluvial basis (spawn in streams but live in lakes). Bull trout tend to prefer cold, clear waters (no more than 64 degrees Fahrenheit). Whatcom Creek does host bull trout, indicating that the trout use the Whatcom Waterway as a migratory path if not a refuge and rearing area.

- **Orca Whales:** On November 15, 2005, the National Oceanic and Atmospheric Administration (NOAA) Fisheries announced its decision to list the North Pacific Southern Resident Orca whale (*Orcinus orca*) population as endangered under the ESA. The listing was effective on February 6, 2006 (50CFR 223/224). The listing is specific to the three resident whale pods (J, K, and L pod) with spring through fall ranges in Puget Sound and the Straits of Georgia and Juan de Fuca. This population was previously (December 16, 2004) proposed for listing as threatened. NOAA Fisheries has announced that they are preparing language for proposed Orca whale critical habitat for this population. A number of factors have been identified by NOAA Fisheries as having resulted in the listing of these Orca whales as endangered. Sound and disturbance from vessel traffic, toxic chemicals which accumulate in top predators, and uncertain prey availability (primarily salmon) all have been identified as concerns for the continued survival of this population. The small number of whales in this group, and relatively slow rate of population recovery since a 20 percent population decline during the 1990s also puts this historically small group at risk of extinction during a catastrophic event such as an oil spill or disease outbreak.

3.3 Land and Navigation Uses

Land within the Whatcom Waterway Site is owned by both public and private entities. Existing uses and use designations are currently changing, and are the subject of an intense community planning effort. Section 3.3.1 below describes current property ownership within and adjacent to the Whatcom Waterway Site. Section 3.3.2 then provides an overview of current land use regulations and planning activities. Section 3.3.3 then discusses in detail the land use and navigation issues for each portion of the site.

3.3.1 Waterfront Land Ownership

A land ownership map is included as Figure 2-2 of this report. That figure represents current waterfront land ownership at the time this report was prepared.

Following completion of the GP-Port transaction in 2005, the majority of the waterfront property located adjacent to the site is owned by the Port. The Port also owns the aquatic lands underlying and adjacent to the majority of the ASB. In addition to property ownership, the Port and Department of Natural Resources (DNR) entered into a cooperative agreement in September 1997 to allow the Port to manage certain state-owned lands through a Port Management Agreement (PMA) (RCW 79.90.475). The Port is responsible for managing the lands covered under the PMA consistent with federal and state regulations and laws, and DNR's land management goals. Parcel 3 of the current PMA includes portions of the Bellingham Shipping Terminal and adjacent submerged aquatic lands near the Barge Dock area.

The majority of the Whatcom Waterway navigation channel and the submerged aquatic lands located offshore of the Whatcom Waterway Site are owned by the State of Washington. The State of Washington also owns the outer corner of the ASB, and filled lands along the shoreline of the RG Haley and Cornwall Avenue Landfill sites.

The City of Bellingham owns the former Colony Wharf site located along the head of the Whatcom Waterway. The City also owns a joint interest with the Port in upland property located adjacent to the Cornwall Landfill.

The U.S. Coast Guard owns a parcel of property located near the head of the I&J Waterway.

Three privately-owned shoreline properties are located in the immediate vicinity of the Whatcom Waterway Site. These include the following:

- Ebenal property located between the Colony Wharf site and the Roeder Avenue bridge
- Douglas Management property, located within a portion of the RG Haley site
- Nielson property, located in between the RG Haley site and Pine Street.

3.3.2 Overview of Land Use Planning Activities

The Bellingham Waterfront areas located within and adjacent to the Whatcom Waterway site are undergoing a transition from historic industrial land uses to mixed use development. This section provides an overview of the land use planning activities that are shaping, and are being shaped by, this change in land use.

Bellingham Bay Comprehensive Strategy

As described in Section 2.1.2, the Bellingham Bay Comprehensive Strategy was developed by a cooperative partnership of agencies, tribes, local government, and businesses known collectively as the Pilot Work Group. The Comprehensive Strategy was intended to provide long-term guidance to decision-makers relating to implementation of sediment cleanup, source control, and habitat restoration actions in Bellingham Bay. The Comprehensive Strategy was finalized as a Final Environmental Impact Statement in October 2000, and it preceded some of the significant land-use changes that have occurred since that time. Yet much of the work of the Pilot, especially that regarding potential habitat restoration actions, remains relevant. While the Port and City are not bound by regulation to implement these potential restoration actions, many of the habitat restoration actions that were identified in Appendix A of the 2000 EIS as furthering Pilot goals have been either implemented, or have been carried forward as part of community land use planning efforts since 2000. These habitat goals are reflected in the Waterfront Futures Group Vision and Framework Plan, and in marine infrastructure planning for the Whatcom Waterway area. The Port, City and other Pilot Work Group members have sought ways to implement the Pilot goals in the context of changing community land use needs.

Shoreline Master Program Update

The City is currently updating their state-mandated SMP which regulates and manages uses and activities within 200 feet of the shorelines of the City. The City and Port are working with the Bellingham community to ensure that the land use vision articulated in the Waterfront Vision and Framework Plan is reflected in the SMP update. The SMP update is expected to be completed in early 2007.

Port Land Use Planning Activities

The Port of Bellingham is responsible to the citizens of Whatcom County for providing shipping and marine cargo facilities, general boating, and maritime industry facilities, as well as assisting in maintaining and developing a healthy regional economy. The Port's main planning tools are area Master Plans, and the Port's Comprehensive Scheme of Harbor Improvements. Over the past 10 years the Port has led and participated in extensive land use planning activities related to Bellingham's waterfront areas. Examples of these activities include the following:

- Land use studies conducted during 1999 and 2000 for the Central Waterfront area
- Master Planning efforts for the Bellingham Shipping terminal and vicinity, also completed in 1999 and 2000
- Alternatives evaluations for sitting of new marina facilities to meet regional moorage demand
- Outreach activities conducted by the Port of Bellingham as part of the GP due diligence process during 2004, including soliciting of extensive stakeholder and public input on potential waterfront cleanup actions, land use alternatives and navigation priorities for the Whatcom Waterway
- Amendment to the Port Comprehensive Scheme of Harbor Improvements identifying the need for future aquatic use of the ASB area for marina development
- Ongoing Port and City leadership land use planning efforts for the redevelopment of the New Whatcom area, including pending development of a final area Master Plan for the "New Whatcom" area of Bellingham's Waterfront. The Master Planning process will include SEPA environmental review of the Master Plan elements.

Waterfront Vision and Framework Plan

In 2004, the Waterfront Vision and Framework Plan was developed by the Waterfront Futures Group, a community land use visioning effort supported by the City and the Port. Key elements of that plan for the areas of the Whatcom Waterway Site (described in the Framework Plan as the City Center area) include the following:

- Develop a mixed-use waterfront neighborhood including new job opportunities and urban housing
- Complete the cleanup and opening of the ASB to accommodate either a new marina or new marine habitat combined with stormwater treatment or some combination of those uses
- Maintain deepwater moorage in the Whatcom Waterway, consistent with other uses and preservation of critical habitat areas.
- Reinforce the Inherent Qualities of Each Place on the Waterfront including integration of water-dependent uses with new commercial, institutional, educational, and residential uses and public spaces
- Restore the Health of Land and Water including enhancement of natural systems, tailoring of cleanup strategies and remediation to planned uses, and restoration and enhancement of beaches wherever possible
- Improve Waterfront Access including connections between uplands and waterfront areas and links to regional trail systems, while respecting natural habitat
- Encourage and promote fisheries and ocean-related research industrial and facilities
- Promote a health and Dynamic Waterfront Economy including mixed-use redevelopment of the former GP Mill site and the uplands area adjacent to the Cornwall Avenue Landfill site
- Provide transient moorage in the Inner waterway, while avoiding impacts to critical habitat in this area
- Provide hand-carry boat landing opportunities within the project area, including at the Cornwall Avenue Landfill and near the ASB
- Enhance the system of connected public open spaces between the Whatcom Waterway and the south end of the Cornwall Avenue Landfill, including open spaces along the waterfront and

completion of the over-water walkway between the Cornwall Avenue Landfill and Boulevard Park

3.3.3 Area-Specific Navigation and Land Use Issues

Land use, navigation, and shoreline public access issues are summarized below by geographic area for different portions of the Whatcom Waterway Site (Figures 2-1 and 3-2). Habitat restoration opportunities consistent with the Bellingham Bay Comprehensive Strategy are also discussed in this section (Subarea Strategies developed as part of the 2000 EIS are attached as Appendix A of the 2006 Draft Supplemental EIS).

Outer Whatcom Waterway

Navigation uses in the Outer Waterway offshore of the Bellingham Shipping Terminal are largely transitory, with vessels coming into and traveling out of the Waterway. Vessels are generally not anchored in these areas, and there are no permanent dock structures or mooring dolphins.

A federal navigation channel is located in the Outer Waterway. Federal navigation channels represent a conditional agreement between the Corps and a local entity (the "local sponsor," in this case the Port of Bellingham) under which the federal government shares the cost and assists with the implementation of certain defined navigation maintenance activities. The limits of the federal commitment are defined geographically by the dimensions of the "project." For the Outer Waterway, the project depth is defined as 30 feet below MLLW and the width varies from 263 feet near the Shipping Terminal to 363 feet in offshore areas.

Under the federal channel maintenance program, the local sponsor can request the Corps to maintain the project depths by periodic maintenance dredging. Subject to federal funds availability, the Corps conducts such dredging under its Operations and Maintenance program. The federal participation is subject to a navigation needs analysis that must show that the dredging is in the national economic interest. This needs analysis considers industrial and commercial navigation uses (e.g., cargo operations, commercial fishing, institutional users) but does not consider recreational, public access, or habitat uses.

If maintenance dredging is performed by the Corps in a federal channel, the local sponsor must provide for sediment disposal and must share certain other costs. The sponsor is responsible for coordinating the costs of development and maintenance of "berth" areas and shoreline infrastructure with local property owners and other interests. The berth areas are the areas located along-side the federal channel that are used for mooring of vessels. In order for the water depth of a federal channel to be usable, the depths in berth areas must be consistent with those in the channel. Otherwise a vessel traveling in the channel would not be able to moor along-side a wharf.

The current water depths in the Outer Waterway are at or slightly below the “project depth” of 30 feet in the federal channel areas. The federal channel boundaries are offset from the wharf areas by approximately 50 feet. This “berth” area is defined along the inshore edge by the “pierhead line” and along the offshore edge by the federal channel boundary. Depths in this area are maintained by local interests. Construction is generally prohibited in areas offshore of the pierhead line, and is regulated by the Corps and the Coast Guard. The pierhead line runs along the face of the docks at the Bellingham Shipping Terminal.

The maintenance of water depths in the berth areas of the Shipping Terminal requires maintenance of substantial shoreline infrastructure. That infrastructure includes bulkheads, engineered armored slopes, and over-water wharves that provide for mooring and loading/unloading of vessels moored at the berths. In order to meet the economic needs test of the Corps maintenance dredging program, upland land uses have been restricted and are designated in the Shipping Terminal area for appropriate water-dependent uses consistent with the federal channel designation.

The Bellingham Shipping Terminal has been used since the early 1900s for cargo shipping and warehousing activities. Multiple future uses have been considered as part of the evaluation of land use changes in the New Whatcom planning area. The Shipping Terminal areas are currently anticipated to continue in water dependent uses. Potential future uses include operation of appropriate institutional users (e.g., Coast Guard or NOAA), limited cargo shipping, or other deep draft navigation uses. It is anticipated that the federal channel will be maintained in the Outer Waterway areas consistent with its current dimensions. The presence of contaminated sediments at depths shallower than 5 feet below the authorized channel depth in this area would interfere with these types of uses by interfering with channel maintenance activities. The shoreline infrastructure required for operation of a shipping terminal is present in this area, though significant maintenance and potential upgrades may be required prior to resumption of deep draft uses.

Shallow-water nearshore habitats in the Outer Waterway area are limited to under-dock areas along the Bellingham Shipping Terminal. Potential habitat restoration opportunities in these areas are limited by the infrastructure needs associated with operation of a deep draft moorage area in support the operations of the federal navigation channel. The Bellingham Bay Comprehensive Strategy reflects this and has no specific restoration recommendations for this area.

Existing habitat conditions are discussed in section 3.2.1 and figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.

Inner Whatcom Waterway

Like the Outer Waterway, the Inner Waterway has historically been used for industrial water-dependent uses. These have included operation of lumber mills, the GP pulp and paper mill, gravel shipping, fish processing and bulk petroleum terminal operations. The federal navigation channel was initially established in the early 1900s with project depths of 18 feet below MLLW (Inner Waterway) and 26 feet (Outer Waterway). This deeper portion of the channel was expanded between 1958 and 1961. Most of the Central Waterfront area was developed when the project depth was 18 feet below MLLW.

The federal project boundaries prohibit Corps dredging within 50 feet of the pierhead lines and structures. This limits the effective water depth in this area due to the lack of supporting berth area depths and requisite shoreline infrastructure. The width of the Waterway is constrained by developed fill areas and upland features adjacent to the Waterway.

Effective water depths in the Inner Waterway are currently limited by the restrictions of the federal navigation channel to the depths at the pierhead line. These depths range from less than zero in some shoaled areas to as much as 22 feet in outer portions of the GP dock. In areas offshore of the Log Pond, the water depths are usable only for transit (i.e., vessels entering or leaving the Inner Waterway), because no shoreline land areas or over-water infrastructure exists in these areas.

The land use restrictions associated with the historic federal channel boundaries are in conflict with both current and planned uses of the Inner Waterway as a result the Port has initiated consultations with the Department of Natural Resources, the Corps, and other parties to update channel designations.

During 2005 the Port and DNR signed a Memorandum of Understanding which included a proposal to update harbor area and Whatcom Waterway channel dimensions. The objective is to provide for a range of uses within the Inner Waterway consistent with local land and navigation uses. The Inner Waterway would be managed by local interests as a Multi-Purpose Waterway, providing a wider range of uses than those supported by the current federal channel designations.

In addition, in May 2006 the Port Commission, after public comment, issued Resolution 1230 which requests that the U.S. Congress de-authorize the Inner Waterway from head of the federal channel at the Roeder Avenue Bridge to Bellingham Shipping Terminal, in order to allow implementation of a Multi-Purpose Waterway, and to focus federal funding participation on the deep draft terminal areas of the Outer Waterway. Language proposing the modifications to the federal channel has been drafted and included in congressional legislation that is expected to be finalized during 2006.

The Inner Waterway includes deepwater areas, and emergent shallow-water habitat at the head of the waterway. The preservation and enhancement of these areas is recommended in the Bellingham Bay Comprehensive Strategy. Recent marine infrastructure planning by the Port has additionally discussed opportunities to preserve and enhance shallow-water habitat along the sides of the Inner Waterway. Existing habitat conditions are discussed in section 3.2.1 and Figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.

Log Pond

As its name implies, the Log Pond was historically used as a log pond for lumber and pulp mill operations. These uses have been discontinued since the completion of the Log Pond Interim Remedial Action in 2000/2001.

The Log Pond has been designated for cleanup and habitat restoration uses. Some public access enhancements to upland shoreline areas are likely as part of future redevelopment of the former GP Mill site. These uses would likely include development of a shoreline promenade along portions of the Log Pond. No in-water navigation uses are contemplated for the Log Pond.

The habitat restoration component of the Log Pond Interim Remedial Action was voluntary implemented by GP in accordance with the recommendations of the Bellingham Bay Comprehensive Strategy.

Since its completion monitoring has confirmed the use of the restored area by juvenile salmonids, juvenile Dungeness crabs, and other aquatic organisms and marine mammals.

In addition some eel grass colonization has occurred. A pilot program has been funded under the Bellingham Bay Demonstration Pilot to enhance natural colonization rates through seeding of the area with eel grass. This pilot test is ongoing.

Existing habitat conditions are discussed in section 3.2.1 and figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.

Areas Offshore of the ASB

The offshore areas near the ASB were historically used for log rafting, prior to construction of the ASB. Future navigation use of these areas is considered limited by water depths and the lack of available upland adjacent to these areas.

To the north of the ASB, along Hilton Avenue, an eel grass bed has become established. The Bellingham Bay Comprehensive Strategy recommends creating shallow water habitat along the remaining perimeter of the ASB to connect with the existing eel grass bed. This area has elevations generally shallower than 5 feet below MLLW, and the area is partially protected from wave energies by the ASB and by a shallow-water leading edge along the bed.

Existing habitat conditions are discussed in section 3.2.1 and figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.

Areas Near the Bellingham Shipping Terminal

Navigation uses in the Barge Dock area have historically included log rafting, barge traffic, and tug boat mooring. Some propeller wash effects may be significant in this area, depending assuming future barge and tug uses. Two docks are located within this area including the barge dock and the former GP Chemical dock. The northern side of the Barge Dock area is bounded by the back side of the Bellingham Shipping Terminal wharf structure.

Some dredging activities have historically been performed in the Barge Dock area, including dredging for establishment of cargo terminal berth areas, as well as dredging to obtain fill material for use in development of a portion of the Bellingham Shipping Terminal. Regular maintenance dredging such as that considered for the Whatcom Waterway areas is not expected. As described above for the Outer Waterway, the Bellingham Shipping Terminal is anticipated remain under industrial water-dependent use, including potential reuse by institutional users and cargo operations.

Like the Outer Whatcom Waterway area, potential habitat restoration opportunities in the Barge Dock area are limited by the navigation uses. The Bellingham Bay Comprehensive Strategy reflects this and has no specific restoration recommendations for this area. Existing habitat conditions are discussed in section 3.2.1 and figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.

Starr Rock

Historic navigation uses in the Starr Rock area were limited to Log rafting. These uses were discontinued in the 1970s with the development of Boulevard Park nearby. Future navigation uses in the Starr Rock area are not anticipated other than transit uses by recreational vessels. Deepwater navigation is restricted in this area due to the proximity of the natural shallow-water obstruction at Starr Rock, and by the lack of adjacent upland navigation support facilities.

The Starr Rock area consists of a deepwater habitat area. The depths in this area do not allow for enhancement of shallow-water habitat uses.

ASB

The ASB facility was constructed by Georgia Pacific for treatment of wastewater and stormwater. It also provides cooling water management for the Encogen energy production facility. These uses are expected to continue through June of 2008, consistent with Port-GP agreements. After that time these uses are likely to be discontinued.

The Bellingham Bay Comprehensive Strategy included a recommendation for removal of the ASB in order to establish intertidal and shallow sub-tidal habitat. However, no funding mechanisms have been identified to implement this type of project, and alternative uses of the ASB have formed the basis of recent land use planning efforts.

During 2004 the ASB was identified by the Port as the preferred site in Bellingham Bay for construction of a new marina facility (Makers, 2004). The preference for the site was based on several factors, including the ability to develop a marina with net gains in both habitat and public access opportunities. Preliminary design concepts for a marina incorporating public access and habitat enhancements were developed by the Port after consultation with resource agencies and project stakeholders. One of these design concepts is presented in the current Feasibility Study and in the Draft Supplemental EIS. The design concept incorporates development of intertidal and shallow sub-tidal habitat, consistent with the general intent of the Bellingham Bay Comprehensive Strategy recommendation. If completed according to that design concept, the ASB marina would reconnect the 28-acre ASB area to Bellingham Bay, and restore nearly 4,500 linear feet of salmonid migration corridors. The acreage of premium nearshore aquatic habitat developed as part of marina reuse would vary depending on final design and berm configurations, with potential habitat bench areas located on the inside and the outside of the berm.

The Port updated its Comprehensive Scheme of Harbor Improvements in 2004 to reflect the future planned use of the ASB for marina development. The Port further developed a funding plan to conduct the cleanup of the ASB and the development of the marina project. The majority of the ASB was acquired by the Port as part of the 2005 GP property transaction. The City has supported the marina development concept as documented in the July 2006 Interlocal Agreement between the Port and the City. Development of a marina in the ASB, and the final design of any such marina, is subject to additional design and permitting evaluations.

The City also evaluated the ASB for potential future stormwater or wastewater treatment uses, but it determined that it is not well suited for these uses due to its location, elevation, and the operational characteristics of the current GP-owned outfall structure.

I&J Street Waterway

The I&J Street Waterway includes a federal navigation channel, with a width of 100 feet and a project depth of 18 feet below MLLW. Berth areas adjacent to the federal channel include a mixture of state-owned and privately-owned lands.

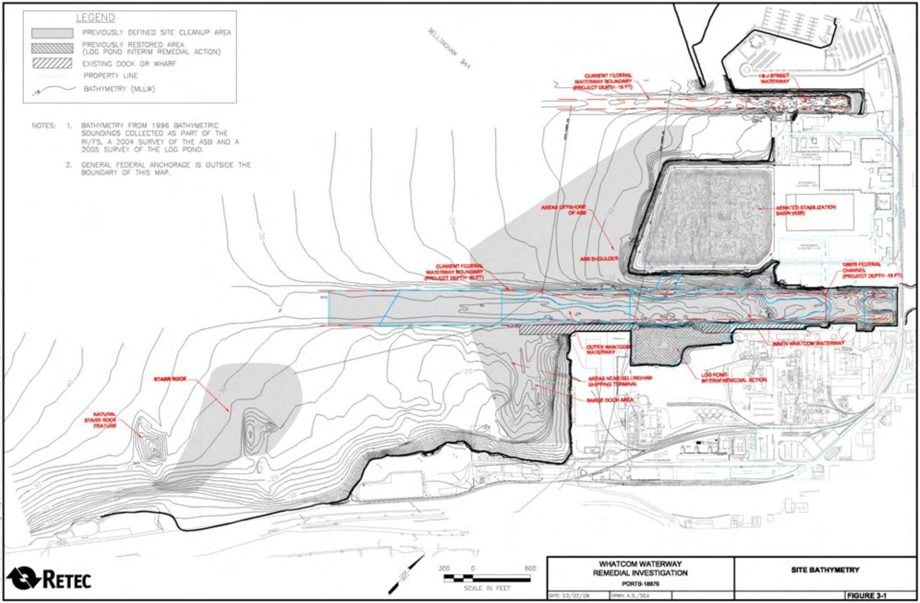
Historic navigation uses in the waterway have included log shipping and navigation in support of lumber mill operations, ore processing facilities, and seafood processing plants. Current navigation uses in the waterway include navigation by commercial fishing vessels destined for the Bornstein Seafoods processing facility, and Coast Guard vessels associated with the Coast Guard station at the head of the waterway. The waterway also provides navigation access for vessels entering Squalicum Inner Harbor, or visiting the Hilton harbor facilities.

At this time there are no anticipated changes to the project depths or location of the federal channel within the I&J Street Waterway, current project depths are shown on Figure 3-1. The shoreline of the area has been maintained with the requisite infrastructure to allow utilization of this water depth, and the mix of uses currently located along the channel are consistent with the Corps Operation and Maintenance program requirements. Maintenance dredging is performed periodically by the Corps of Engineers in conjunction with the Port and other parties. Sediment testing performed as part of the RI/FS (Appendix H) has indicated that recently accumulated sediments within the outer waterway are consistent with criteria for open-water disposal. The Corps most recently dredged portions of the I&J Waterway in 1992. No additional actions associated with Whatcom Waterway constituents are required in the outer waterway areas. Based on site data regular Corps operation and maintenance program requirements contain adequate material characterization.

Accumulated sediments located near the head of the waterway are being evaluated as part of the RI/FS process for the I&J Waterway site.

The I&J Street Waterway is similar to portions of the Inner Waterway, in that the main waterway area consists of deepwater areas, and most shorelines along the sides of the waterway are currently engineered to support navigation uses. However, there is a shallow intertidal area that has developed at the head of the state waterway, past the end of the federal channel. The future uses of this area are subject to evaluation in ongoing area land use planning activities. Land at the head of the I&J Street Waterway has been considered as a potential public access location.

Existing habitat conditions are discussed in Section 3.2.1 and Figure 3-2 shows the shore line features including bulkheads, armored slopes, and overwater structures.



File: H:\18876\18876ST43.dwg Layout: FIGURE 3-1 User: emarshall Plotted: Oct 04, 2006 - 9:00am Xref's:

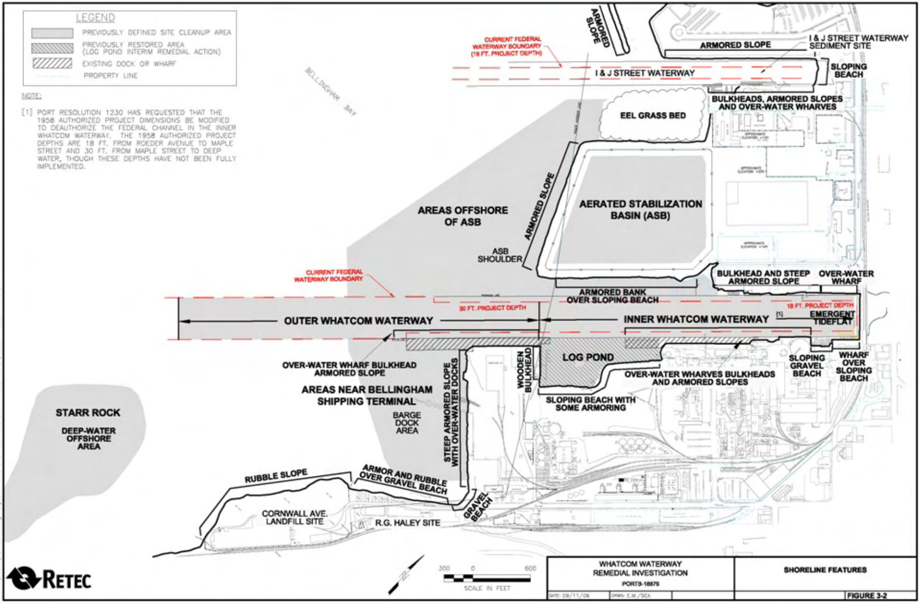
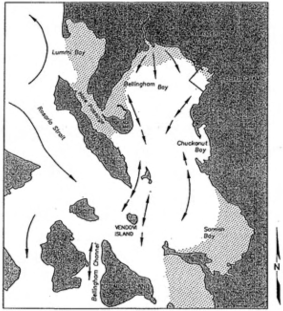

LEGEND
PREVIOUSLY DEFINED SITE CLEANUP AREA
PREVIOUSLY RESTORED AREA (LOG POND INTERIM REMEDIAL ACTION)
EXISTING DOCK OR WHARF
PROPERTY LINE
NOTE:
[1] PORT RESOLUTION 1230 HAS REQUESTED THAT THE 1958 AUTHORIZED PROJECT DIMENSIONS BE MODIFIED TO DEAUTHORIZE THE FEDERAL CHANNEL IN THE INNER WHATCOM WATERWAY. THE 1958 AUTHORIZED PROJECT DEPTHS ARE 18 FT. FROM ROEDER AVENUE TO MAPLE STREET AND 30 FT. FROM MAPLE STREET TO DEEP WATER, THOUGH THESE DEPTHS HAVE NOT BEEN FULLY IMPLEMENTED.
BELLINGHAM BAY
CURRENT FEDERAL WATERWAY BOUNDARY (18 FT. PROJECT DEPTH)
ARMORED SLOPE
I & J STREET WATERWAY
I & J STREET WATERWAY SEDIMENT SITE
SLOPING BEACH
BULKHEADS, ARMORED SLOPES AND OVER-WATER WHARVES
EEL GRASS BED
AERATED STABILIZATION BASIN (ASB)
AREAS OFFSHORE OF ASB
ASB SHOULDER
BULKHEAD AND STEEP ARMORED SLOPE
OVER-WATER WHARF
CURRENT FEDERAL WATERWAY BOUNDARY
ARMORED BANK OVER SLOPING BEACH
30 FT. PROJECT DEPTH
18 FT. PROJECT DEPTH
OUTER WHATCOM WATERWAY
INNER WHATCOM WATERWAY
[1]
EMERGENT TIDEFLAT
OVER-WATER WHARF BULKHEAD ARMORED SLOPE
STEEP ARMORED SLOPE WITH OVER-WATER DOCKS
WOODEN BULKHEAD
LOG POND
OVER-WATER WHARVES BULKHEADS AND ARMORED SLOPES
SLOPING GRAVEL BEACH
WHARF OVER SLOPING BEACH
AREAS NEAR BELLINGHAM SHIPPING TERMINAL
BARGE DOCK AREA
SLOPING BEACH WITH SOME ARMORING
STARR ROCK
DEEP-WATER OFFSHORE AREA
RUBBLE SLOPE
ARMOR AND RUBBLE OVER GRAVEL BEACH
GRAVEL BEACH
CORNWALL AVE. LANDFILL SITE
R.G. HALEY SITE
300 0 600
SCALE IN FEET
RETEC
WHATCOM WATERWAY REMEDIAL INVESTIGATION
PORTB-18876
DATE: 09/11/06
DRWN: E.M./SEA
SHORELINE FEATURES
FIGURE 3-2

Figure 3-3 Bellingham Bay Circulation Patterns

Net Current Directions in Greater Bellingham Bay



0 15000 30000
Approximate Scale in Feet

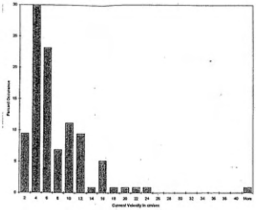
Shoal Areas (< 20 Feet MLLW)

Net Current Drift Directions Inferred from Puget Sound Environmental Atlas (1987) and Collias (1966)

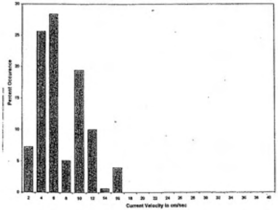
Distribution of Current Velocities

Whatcom Waterway

Shallow Current Velocities

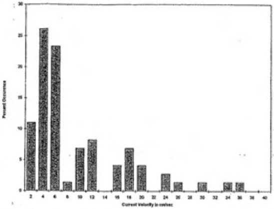


Deep Current Velocities

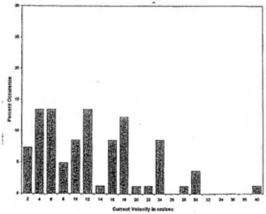


Inner Bellingham Bay

Shallow Current Velocities



Deep Current Velocities



Note: Shallow velocities from less than 2 meter depth below water surface.
Deep velocities from greater than 2 meter depth below water surface.

Data from Colyer (1998)